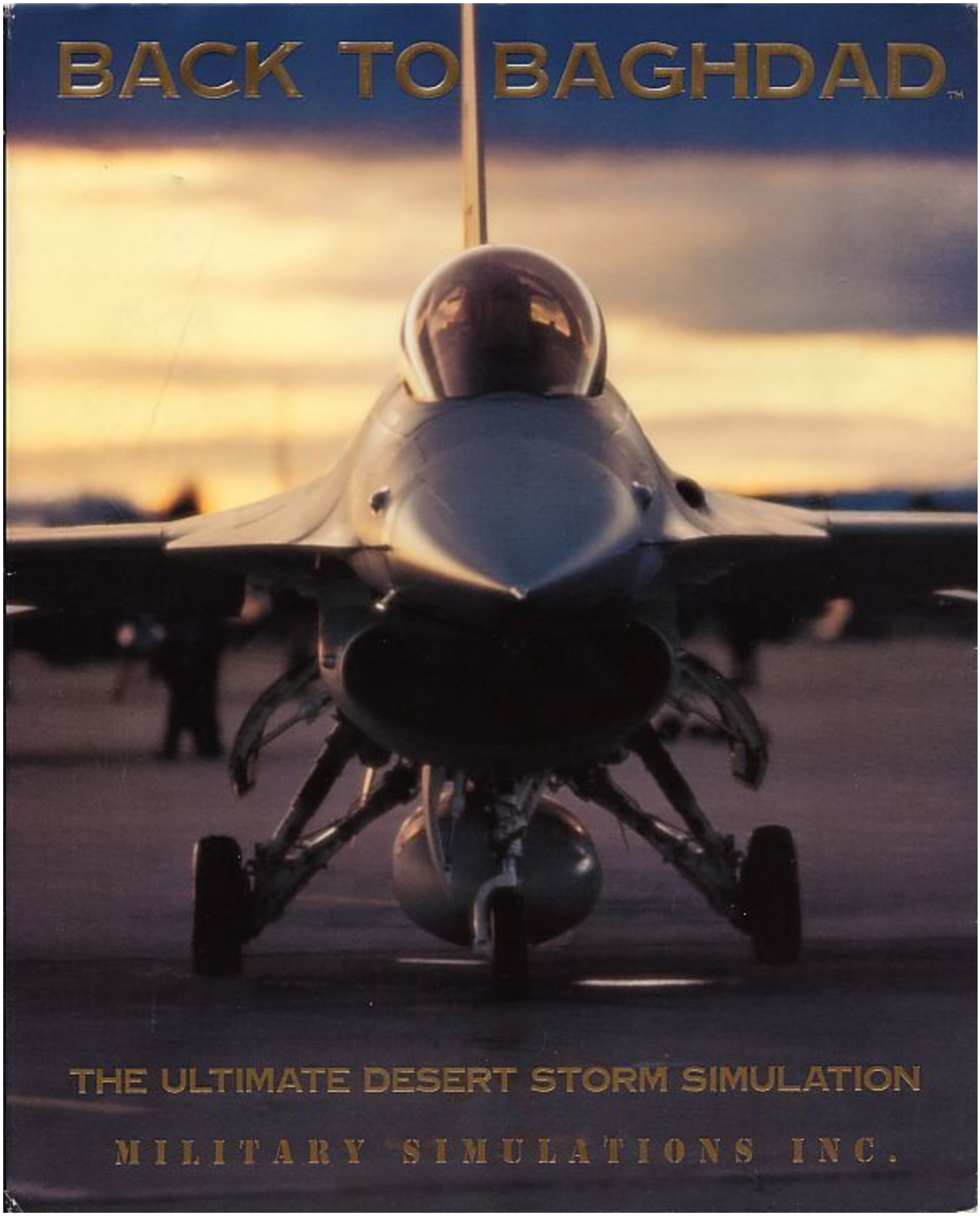



**B2B Flight Manual: Compiled By PinFox80.**

# 1.0 INTRODUCTION

This supplement is intended to augment the "procedures to operate the sim" information contained in the B2B Flight Manual that is packaged with the sim. For additional information on USAF and enemy tactics, F-16 maneuvers, missions and the theatre of operations, obtain the B2B "3-1" Manual.

# 2.0 CONTROLS

# 2.1 PRIMARY FLIGHT CONTROL

### *2.1.1 STICK AND PEDALS*

We strongly encourage the use of a joystick in the playing of Back to Baghdad. You will find control of the aircraft substantially easier than either keyboard or mouse control. In the absence of a joystick, one option for basic flight control is the mouse. Aft stick is applied by pulling the mouse toward you, forward stick by pushing the mouse away. Similarly, right stick is achieved by pushing the mouse to the right, left stick to the left. Alternatively, players equipped with a numeric keypad on the right of the keyboard can use 2 for aft stick, 8 for forward stick, 6 for right stick and 4 for left stick. Additionally, hitting 5 will center the stick. Control for rudder pedals is another keyboard option. In Back to Baghdad (as in the real F-16) rudder control is used only for minor landing corrections and for minor adjustments during gun runs. Otherwise, the digital flight system is designed to keep the aircraft flying with zero sideslip and indeed, will correct out any rudder inputs rather quickly. Nonetheless, rudder control is provided for in two locations (in addition to supporting actual rudder controls), The first set of keyboard rudder controls are the period (.) for right rudder) and the comma (,) for left rudder. Alternatively, the 3 and 1 on the numeric keypad can be used for right and left rudder respectively when available. The ideal method of rudder control is via a set of Thrustmaster Rudder Pedals.

### *2.1.2. ENGINE*

When mission starts on the ground, the scenario may begin with the engine off. The engine is started by hitting 9. The engine is turned off by hitting 0. The throttle can be increased by hitting = and decreased by hitting -. Finally, the afterburner stage is increased by hitting \ and decreased by hitting SHIFT \ (i.e. |). For keyboards with numeric keypads, a duplicate set of engine control keys is provided. + throttles the engine up, - down. Obviously, the throttle control function can be accomplished via throttle control set for players with such equipment. To start the engine (either on the ground or in the event of a flame-out or damage), the throttle/fuel flow must be set at idle level.

### *2.1.3 AUXILIARY FLIGHT CONTROL FUNCTION*

Hitting the up arrow at any point will cause the view to shift up. The use of the arrow keys for the eyes out of cockpit views allows to visually check essentially all the site lines available to the pilot.

## 2.2 WEAPON FIRE CONTROL

### *2.2.1 WEAPON SELECTION AND RELEASE*

The basic mode change between air-to-air mode and air-to-ground mode is controlled by the type of weapon selected. Selection of air-to-air mode is accomplished by hitting 3, air-to-ground by hitting 4. Cycling between available weapons is accomplished by repetitively hitting the applicable key. That is, hitting 3 will cycle among the onboard air-to-air weapons including the gun if available. Hitting SHIFT 3 will go the previous weapon on the cycle. Air-to-ground works in the identical way with 4. In both A-A and A-G, after cycling through onboard weapons, NAV mode becomes available as an option in the rotary. Also, air-to-air weapons can be selected and cycled from the 7/HOME key and air-to-ground weapons from the 9/PG UP key. All weapons except the gun are released by hitting the ENTER key. For keyboards with the numeric keypad, weapons can be fired from it's ENTER key. The gun is fired by hitting the SPACE BAR.

### *2.2.2 DOGFIGHT SWITCH*

When an AIM-9M is loaded, the D key provides control over the dogfight mode switch position. The Dogfight switch has three positions that allow the player to quickly select a short range weapon and radar combination when in a dogfight or for other times when a quick shot is desired. The three positions are outboard, center, and inboard. The outboard settings, selected by hitting SHIFT D, automatically selects an AIM-9M missile and ACM mode in the radar. The inboard position, achieved by hitting ALT D, automatically selects an AIM-120 missile and TWS radar mode. The center position, selected by hitting D, sets in the weapon and radar to the modes you had before you invoked one of the dogfight switch positions. Thus, if you were in gun mode with STT radar mode, when you hit SHIFT D the systems would switch to AIM-9M/ACM. Hitting D will set you back to gun and STT.

### *2.2.3 STORES JETTISON*

Onboard stores have a substantial effect on the maneuverability of your aircraft. To select the store to jettison, hit the Z button until the desired store is displayed on the MFD with the stores display selected. To return to the previous store in the cycle, hit SHIFT Z. To jettison the selected store, hit ALT X. The ALT key is used to avoid accidentally jettisoning a store by hitting the wrong key.

## 2.3 RADAR SENSOR OF INTEREST CONTROL

### *2.3.1 SENSOR OF INTEREST*

To control any of the target related sensors on board the aircraft (radar, threat warning indicator system, JTIDS, EO display), the sensor must be selected as the Sensor of Interest. This is accomplished by hitting the 8 key until the red selection lamp is lit on the desired display. SHIFT 8 selects the previous sensor in the cycle.

### *2.3.2 RADAR MODE CONTROL*

The radar is activated by hitting the R key and put in Standby mode by hitting R again. As discussed earlier, air-to-air mode for the radar is selected by hitting 3, air-to-ground by hitting 4. In either air-to-air or air-to-ground mode, the radar mode is cycled forward by hitting 2, cycled backward by hitting SHIFT 2. For keyboards with numeric keyboards, radar mode can be cycled by hitting the * key. The rotary order for air-to-air radar modes is RWS > SAM > STT > ACM > TWS The rotary order for air-to-ground radar modes is GM > FTT > GMTI > GMTT.

### *2.3.3 RADAR RANGE*

The displayed range on the radar can be varied from 5 to 80 miles. Hitting R increases the range to the next level, SHIFT R decreases the displayed range. Note; as the displayed radar range is decreased, there may be detected targets beyond the selected display range that do not get displayed.

### *2.3.4 RADAR SCAN VOLUME*

The scanned volume of the radar is variable in both azimuth and elevation. To increase the azimuth volume of the radar, hit ]; to decrease the volume hit SHIFT ]. To increase the elevation volume, hit [, to decrease SHIFT [. In certain radar modes, the selected elevation coverage is displayed on the left center of the radar MFD. Note that the time it takes to scan the complete selected volume increases with the volume. Thus, while selecting a large volume provides for a larger sensed area, it takes longer to develop track files and target maneuvers will not be detected as quickly as in a smaller volume.

### *2.3.5 RADAR SCAN DIRECTION*

The radar is slewable in the sense that the center of the scan can be offset from the boreline of the aircraft. To move the scan center to the right, hit '; to the left SHIFT ' (i.e. "). To move the elevation pointing angle up, hit ;. To lower it down hit SHIFT ; (i.e. :). To zero the elevation pointing angle (i.e. point it along the aircraft boreline), hit ALT ;. In certain radar modes, the altitude coverage of the radar at the range of the designated target or the radar cursor is displayed on the left center of the radar MFD.

### *2.3.6 RADAR TARGET DESIGNATION*

The radar offers the capability to automatically step through the detected targets in certain radar modes. This is called designating the target. To designate a radar target, place the radar acquisition bars around the target and click the mouse (assuming you are not flying the aircraft with your mouse). Alternatively, to designate that target, hit `. To un-designate a target, hit SHIFT ` (i.e. ~). You can "quick-step" between targets by hitting 1. Hit SHIFT 1 (i.e. !) to return to the previous target on the display. Quick-stepping can also be achieved from the / key on keyboards with numeric keypads.

### *2.3.7 TWIS MODE CONTROL*

The Threat Warning Indicator System has the ability to present audio signals of threats. The default condition for this feature is Off. To activate the active audio mode, hit 2 when the TWIS is the sensor of interest and there is a target displayed. To select low altitude mode for active audio presentation, hit SHIFT 2 (i.e. @) when the TWIS is the sensor of interest. To cycle among the TWIS targets to listen to each threats signal, hit 1 to cycle forward and SHIFT 1 (i.e. !) to cycle to the previous threat.

### *2.3.8 EO DISPLAY CONTROL*

When the EO display is the sensor of interest, you can slew the seeker head of the weapon around its gimbal limits with the mouse (assuming you are not flying with the mouse). When you find a target of interest, you can designate that target by hitting `. If the target is deiscernible from the background by the EO system, it will lock on and display a locked cue. If the target can't be acquired, the EO display will drift with your aircraft. You can free the seeker up by hitting SHIFT ` (i.e. ~). The EO display also features a wide field of view and a normal field of view. The normal field of view provides a longer seeker acquisition range while the wider field of view provides the obvious at the expense of range. EO system FOV is toggled through the use of ].

### *2.3.9 IFF CONTROL*

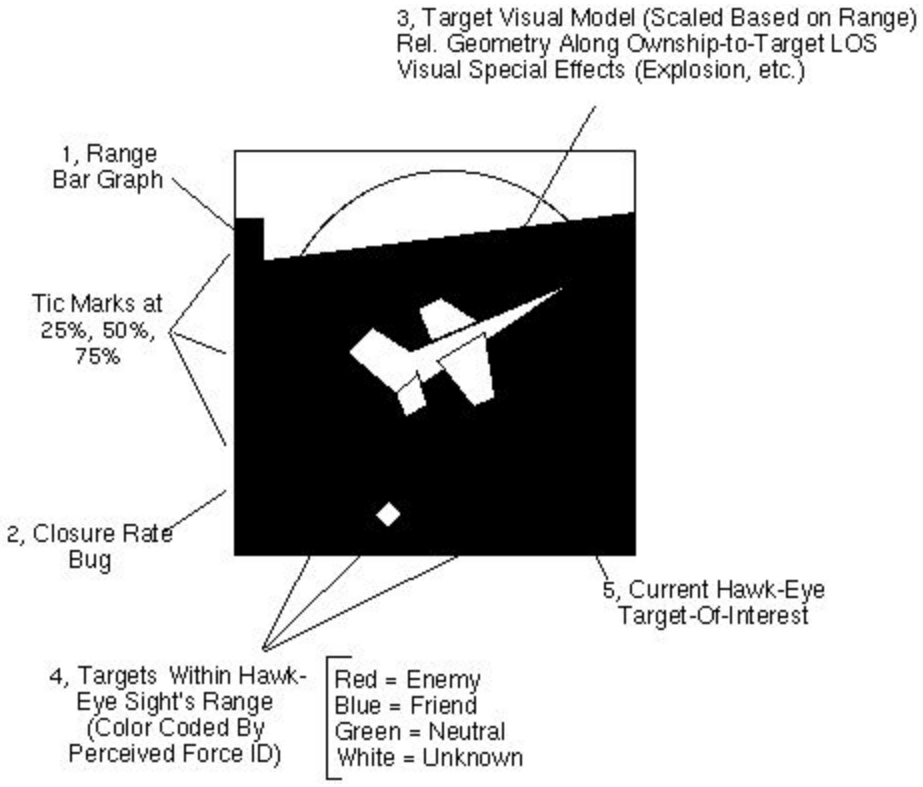
The IFF system conducts an interrogation of the designated sensor target when the I key is hit. The result of the interrogation is presented in the text window on the cockpit display. When the interrogated target is friendly, there is also an audio return (a single beep).

### *2.3.10 JTIDS CONTROL*

The displayed range of the JTIDS system can be varied by hitting O to increase the displayed range from 5 to 80 miles and SHIFT O to decrease the range.

### *2.3.11 HAWKEYE SIGHT TARGETS*

ALT U activates the Hawkeye site which displays the target of interest behind the ownship. The display appears on the forward view as long as the orientation of the selected target is not within the FOV of the HUD. ALT U acts as a toggle control on the Hawkeye site to deactivate it. To cycle between multiple targets behind ownship, hit ALT 1. Figure 2.3.11 depicts the Hawkeye Sight display.




## 2.4 COUNTERMEASURE CONTROL

Your F-16 features three self-defense countermeasure systems : chaff bundles, flares, and an active jammer. Chaff is released in single bundles by hitting C. Flares are released singly by hitting F. The jammer is activated by hitting J which acts as a toggle switch. For key boards with numeric keypads, flares and chaff can be dropped by hitting the del/. key for flares and the ins/0 key for chaff.

## 2.5 NAVIGATION CONTROL

The navigation system features an autopilot to maintain level flight, a TACAN system to select and display navigation waypoints, and an Instrument Landing System to support landing. A functional description of the NAV system is available in Section 5.0.

### *2.5.1 AUTOPILOT CONTROL*

The autopilot is activated by hitting A and is deactivated by hitting A again. When the TACAN system is activated (see section 2.4.2), the autopilot will correct the ownship flight to point directly at the current selected waypoint. When the aircraft reaches the waypoint, the autopilot will cause the aircraft to circle the waypoint. When the TACAN system is not activated, turning the autopilot on will put the aircraft in straight and level flight from all flight conditions and disable stick (manual) control.

### *2.5.2 TACAN SYSTEM CONTROL*

The Navigation MFD displays the TACAN information when selected. The TACAN system is activated by hitting T, deactivated by hitting T again. The current waypoint is displayed on both the JTIDS and radar as an upside-down T. To display your current position, hit SHIFT T with the position displayed on the cockpit text window. To cycle to the next waypoint, hit W. To cycle back to the previous waypoint, hit SHIFT W. When the autopilot is active, the aircraft will turn to the new waypoint as soon as W or SHIFT W is hit (whether or not the old waypoint has been reached).

### *2.5.3 INSTRUMENT LANDING SYSTEM (ILS)*

The ILS system is activated by hitting I. This action switches the HUD display mode and causes airbase information to be presented on the radar and JTIDS. To cycle to the next airbase in the rotary, hit Y, to return to the previously selected airbase hit SHIFT Y. For airbases with multiple runways, you can cycle between them by hitting ALT Y.

## 2.6 COCKPIT DISPLAY CONTROL

There are two Multi-Function Displays (MFD) in the cockpit and another optional MFD display on the Hercules external display. Hitting 5 cycles the left MFD between the available MFD displays (radar, JTIDS, navigation, EO, damage, stores, Off) while SHIFT 5 selects the previous left MFD display. Hitting 6 similarly cycles the right MFD. When the Hercules display is available, hitting 7 cycles it's display through all MFD modes except EO.

## 2.7 HEADS-UP DISPLAY CONTROL

The HUD is toggled on/off by hitting H. There are several colors of HUD displays available. The color is cycled forward by hitting SHIFT H and cycled backward by hitting ALT H. In certain HUD modes (which are determined by factors such as weapon select, ILS select, etc), there is a large amount of information displayed. To de-clutter non-critical displayed elements, hit U. To return to the full HUD display, hit U again. To de-clutter only the pitch ladder, hit SHIFT U which acts as a toggle switch.

## 2.8 VIEW CONTROL

Back to Baghdad features a comprehensive choice of viewing locations. From each view location, the orientation of the view can be changed in angle and range.

### *2.8.1 PRIMARY VIEW SELECTION*

The ten function keys F1 through F10 provide the choice for the primary view as described in the table below.

F1 - Cockpit View - Nominal view of HUD and upper portion of instrument panel.
F2 - HUD View - View of HUD and increased out the cockpit forward view.
F3 - Instrument View - View of entire instrument panel and no HUD view.
F4 - MFD View - Full screen view of only selected MFD.
F5 - Chase View - View behind ownship.
F6 - Weapon View - View of last weapon launched while inflight.
F7 - Allied View - View of friendly aircraft.
F8 - Target View - View of radar detected targets.
F9 - Ground Site View - View of ground sites whether friendly or hostile.
F10 - Recon View - Bird's eye view from above ownship.

For the Weapon, Allied, Target, and Ground site views, there are additional viewing options. Toggling the appropriate function key will change the view from outside the selected entity to a view looking out from the entity. Additionally, you can cycle between the entities available for display in each mode by hitting 1 (or SHIFT 1 to return to the last entity). Note that when the entities being manipulated for display are detected by the radar and the radar is the sensor of interest, you are changing the designated radar target when you are hitting 1. For views oriented from within the cockpit (i.e. Cockpit, HUD, and Instrument Views), you can also manipulate the view via the cursor control keys (i.e. arrow keys). The up and down arrows allow you to look up or down within the cockpit. That is, from the nominal cockpit view, you can go to HUD view by hitting the up arrow. Similarly, you can go to instrument view by hitting the down arrow. When looking down, hitting the left or right arrow will go to the appropriate MFD only display. When you are in either Cockpit or HUD view, hitting the left or right arrow will cause the display to shift 90 degrees in the selected direction. Repetitively hitting an arrow key will keep turning you 90 degrees until you are looking behind the aircraft and eventually back to the forward view. Hitting the up arrow at any point will cause the view to shift up. The use of the arrow keys for the eyes out of cockpit views allows to visually check essentially all the site lines available to the pilot.

### *2.8.2 VIEW TAILORING*

Once an external view (Chase, Weapon, Allied, Target, Ground Site, or Recon) is selected from a function key, you can change the angle from which you are viewing the entity. To change the view angle in azimuth, hit the right or left cursor control arrows. To change in elevation angle, hit the up or down arrows. Repetitively hitting the up arrow will eventually result in a view directly above the selected entity. The effective viewing distance to the entity can be changed by hitting the PAGE UP (move closer) or PAGE DOWN (move farther away) keys. You can return to the original view by hitting HOME.

## 2.9 MISCELLANEOUS CONTROLS

### *2.9.1 PAUSE*

The Escape key is used to pause the game. When ESC is hit, a screen comes up offering four options - Continue game, End Mission, Save Current State, or Exit to DOS. Select the option by hitting the up or down arrow keys until the desired option is selected and then hit RETURN. Note that when ESC is hit, the current mission completion status is presented in the left MFD. This tells you whether a mission is considered complete yet and, if not, what you must do to complete the mission. If you End Mission or Exit to DOS and the mission is not complete, it will not be counted as a successful mission.

### *2.9.2 QUICK TIME*

Back to Baghdad features the ability to increase time steps by factors ranging up to 5 times real time. This feature is selected by hitting Q to increase time step and SHIFT Q to decrease time step. The current time step factor is displayed on the lower left of the HUD. When moving in Quick Time, all mission parameters are still active including ownship avionics and all threat activities. Thus, Quick Time should only be used during quiet portions of a mission or you may increase the chance of being jumped and killed by threats before you can react.

### *2.9.3 TOD*

Back to Baghdad missions are set at various times of the day including night. To change the time of day for a mission, which effects visibility, press the N key until the desired level of lighting is present.

### *2.9.4 SOUND CONTROL*

All sounds can be toggled off by the S key.

### *2.9.5 SCREEN SAVE*

Back to Baghdad features the ability to capture any current screen by hitting ALT /. Saved screen shots are stored in the directory B2B/shots. Saved screen shots can be viewed by most PC paint routines that can read .BMP files.

# 3.0 SENSORS

# 3.1 APG-68 RADAR

The primary sensor in the F-16C is an APG-68 high power multi-mode pulse doppler radar. "Back to Baghdad" incorporates a radar model with many of the features of the APG-68 including both air-to-air and air-to-ground modes with appropriate displays for each mode. Radar range performance varies with target type, radar mode, avionics difficulty and, for air targets, also target solid aspect angle. The highest avionics difficulty reflects realistic radar performance. Lower levels of avionics difficulty generally will artificially increase radar performance and also simplify steps in its use to make the radar easier to manage.

### *3.1.1 RADAR MODES*

The radar is either in standby or in a radiating mode. When radiating it is susceptible to detection by other aircraft radar warning receivers. With the radar selected as the sensor of interest, pressing the "toggle radar" key (keyboard "R") causes the radar to toggle between standby and either air-to-air or air-to-ground modes depending on master mode state. Air-to-air master mode (including radar) is selected by pressing "Cycle AA Wpn" (keyboard "3"). Repeated pressing cycles through the various air-to-air weapon selections. Air-to-air radar modes are described as follows:

**RWS, Range While Scan** - Most sensitive search mode but only range and bearing data on all targets within detection range and scan volume are available. Pilot may select a target by using the acquisition symbol or by "quick stepping" through all detected targets by pressing the "Cycle Sensor Target" key (keyboard "1"). Altitude will be provided for the selected target only. This mode has the greatest detection range but a slow update rate. The radar starts in this mode when cycled from STANDBY.

**SAM, Situation Awareness Mode** - Must enter with target selected. STT on selected target plus continued detections on targets within detection range and scan volume. No cursor is available and pilot cannot re-select target. Fast updating track on selected target while maintaining some information on other targets.

**STT, Single Target Track** - Must enter with target selected. Best track on selected target but no cursor available and pilot cannot change target. No other targets are shown. There are no scan limits except radar gimbals. Good for weapon firing on selected target.

**ACM, Air Combat Mode** - Automatic acquisition of closest target in a cone in front of ownship. No cursor is available, but pilot can reject acquired target to see if another target is now closer.

**TWS, Track While Scan** - Full track data on all targets within detection range and scan volume. Radar automatically selects highest priority target but the pilot may cycle through all detected targets by pressing the "Cycle Sensor Target" key (keyboard "1"). This mode provides good information on all targets but has a slow update rate. Selection among these modes is made by pressing the "Cycle Sensor Mode" key (keyboard "2"). Repeated presses step through the modes in the order above. Reverse order may be selected by using "shift-Cycle Sensor Mode".

Air-to-ground master mode is selected by pressing the "Cycle AG Wpn" key (keyboard "4"). Air-to-ground and air-to-air master modes are mutually exclusive. Repeated pressing of "Cycle AG Wpn" causes the air-to-ground weapon select to step through the available weapons. Air-to-ground radar modes in order of sequencing are:

**GM, Ground Map** - Displays detectable stationary ground targets which are within scan coverage. Any detected target may be selected by the pilot as the designated target by pressing the "Cycle Sensor Target" key (keyboard "1") repeatedly until the desired target is reached. This is basically a surveillance and target selection mode.

**FTT, Fixed Target Track** - Must be entered with a target selected. The radar tracks the selected target within radar gimbal coverage. This mode is required for a valid launch of any air-to-ground weapon against a fixed target .

**GMTI, Ground Moving Target Indicator** - Displays all detectable moving ground targets within scan coverage. Target may be selected by the pilot as in GM. Each target must have a radial velocity of plus or minus 15 FPS (approximately 10mph) to be detectable in this mode.

**GMTT, Ground Moving Target Track** - Must be entered with moving target selected from GMTI. Radar automatically tracks selected target within scan coverage. This mode is required for a valid launch of any air-to-ground weapon against a moving target. As with air-to-air mode, air-to-ground modes are cycled through in the above order by pressing the "Cycle Sensor Mode" key (keyboard "2"). "shift-Cycle Sensor Mode" will reverse the cycling direction. If a tracked target is lost due to leaving the scan coverage, the radar switches back to the appropriate search mode.

### *3.1.2 RADAR DISPLAYS*

Each radar mode has an associated display. In general, air-to-air modes use a "B scan" which is range versus azimuth bearing to the target(s). The radar display is square with range up and azimuth bearing horizontal with ownship located at the bottom center. This format is the same as that used in the actual radar but results in distortion at short ranges. As a target is

approached, the azimuth bearing begins to increase rapidly unless headed straight at the target. Some experience is required to adapt to this.

Radar mode is displayed in the upper left corner with the following symbols:

STBY Standby
RWS Range while search
SAM Situation awareness
STT Single target track
ACM Air combat mode
TWS Track while scan
GM Ground map
FTT Fixed target track
GMTI Ground moving target indicator
GMTT Ground moving target track

Targets are indicated on the display with one of the following symbols at the range and azimuth bearing from the ownship. The numbers reference labels of display icons on figure 3.1-10.

Icon # - Symbol - Description

16A - Square - Detected target
16B - Square with tic - Tracked target
16C - Diamond - Designated target
16D - Circled diamond with tic - Tracked designated target
16E - Circle with X - Target employing ECM against radar
16F - Square with hat - Ground target that is radiating
16G - Diamond with hat - Radiating designated ground target
23 - Inverted T - Current way point location
16B - Tic mark indicates target heading octant (only 8 values) with up indicating tail target aspect.
15 - Heavy vertical lines indicate ownship radar is being jammed on that azimuth bearing but target range is not available.

**Air-to-air Scan Control**

Some radar modes scan the antenna in azimuth and elevation. Air-to-air scanning modes are:

RWS
SAM
ACM (during search only)

Azimuth scan limits are shown as two vertical lines at the azimuth edge of the scan pattern. Scan center is under pilot control using the cursor (except for TWS Mode). Moving the cursor to the edge of the scan pattern will cause the scan pattern to follow the cursor. The scan center will stay where it is left relative to the ownship when the cursor is returned to within the scan coverage. Azimuth scan center may also be moved by pressing the "Cycle Sen Scan Dir" key (keyboard" ' " (single quote)). Azimuth scan size may be cycled among available options by hitting the display side with the cursor or pressing the "Cycle Sen Scan Vol Az" key (keyboard "]").

Elevation scans are fixed elevation angles during one azimuth scan, then step to another elevation angle either one beamwidth above or below. These are known as "bars" and the pilot has control over the elevation bar pattern from among those available. Generally 1, 2, 3, and 4 bar patterns are available. However, not all combinations of azimuth and elevation patterns are available in some modes. Elevation scan pattern may be toggled by pressing the "Cycle Sen Scan Vol El" key (keyboard"["). The elevation scan center may be moved by pressing the "Cycle Sen Scan Dir El" key (keyboard ";"). Direction may be controlled by using the shift key. In air-to-air modes with a cursor, altitude coverage at the range of the cursor is shown in thousands of feet at the top right and lower right of the cursor.

**Radar Display Range Scale Control**

Radar range scale is the term used to describe the maximum range which can be displayed. The bottom of the display is usually zero range. The top of the display is then the range scale. Values available are:

5nm
10nm
20nm
40nm
80nm

The value is indicated in nautical miles on the left edge of the display one quarter of the distance from the top between two vertical arrows. The range scale may be cycled by moving the cursor to the top of the display to increase the range or the bottom of the display to decrease it. It may also be cycled by pressing the "Cycle Radar Range" key (keyboard "P") or "shift-Cycle Radar Range" to increase or decrease it respectively.

**Air-to-air Displays**

The radar display appears on either Multi-functional Display (MFD) selectable by the pilot. The left MFD display cycles through all options by pressing the "Cycle Left MFD" key (keyboard "5") and the right MFD by pressing the "Cycle Right MFD" key (keyboard "6". The MFDs cycle through:

Radar
Damage
Stores
Navigation
JTIDS

Weapon launch zone information is shown along the right edge of the display. The three bars are for the weapon selected, are scaled to the display range scale, and indicate:

Top bar - maximum launch range in nm.
Middle bar - optimum launch range in nm.
Bottom bar - minimum launch range in nm.

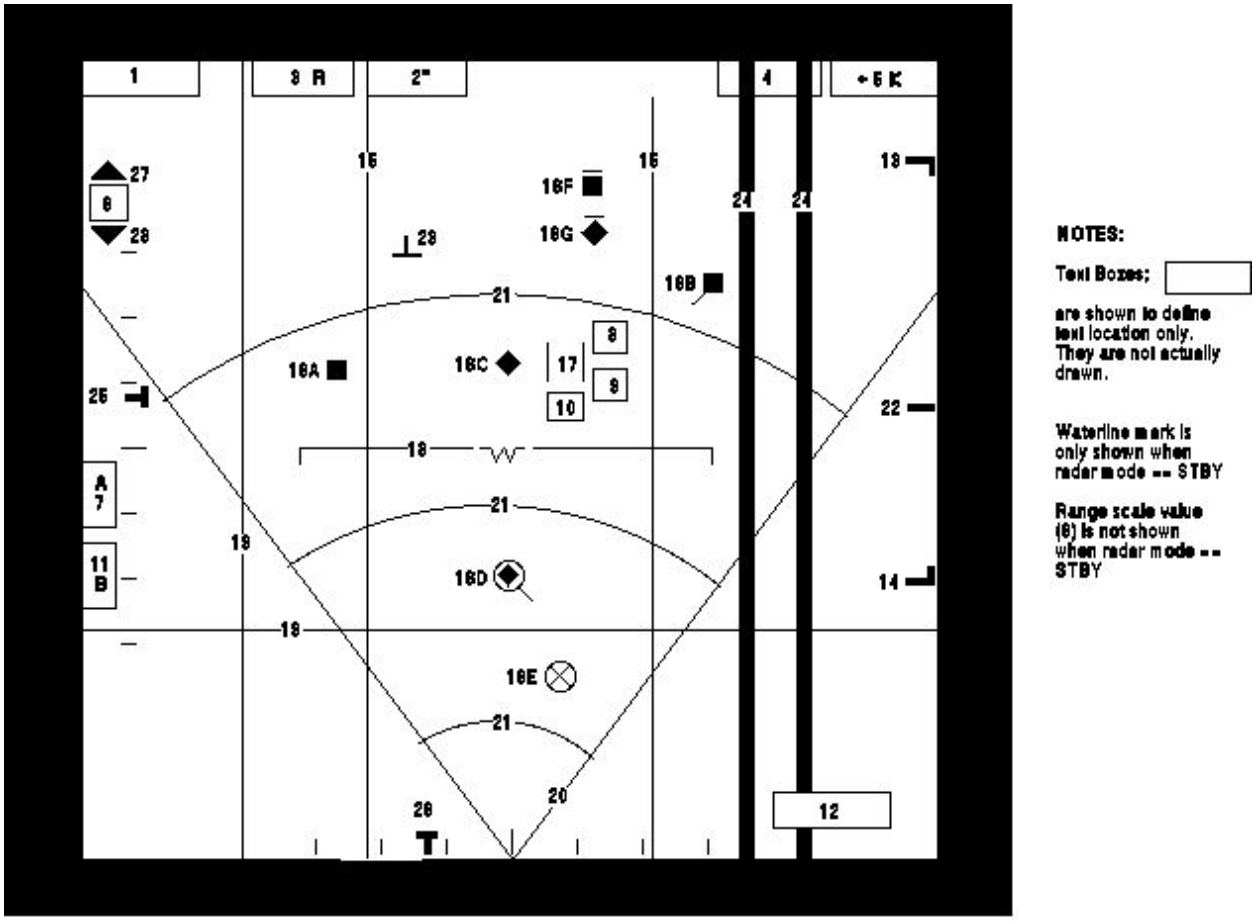
This information only appears when a weapon is selected and a tracked target is designated.

**Air-to-ground Displays**

Air-to-ground radar displays are a Plan Position Indicator (PPI) format which is a range versus range display with the ownship located at the bottom center with ownship heading up. They are available when air-to-ground master modes are selected and may be brought up on either MFD by the pilot. Pressing the "Cycle AG Wpn" key (keyboard "4") selects air-to-ground mode. Pressing the "Cycle Left MFD" key (keyboard "5" cycles the left MFD through available displays the same as in air-to-air mode except that air-to-ground radar appears as the radar display. Similarly, pressing the "Cycle Right MFD" key (keyboard "6") cycles the right MFD.

Azimuth scan coverage control functions similar to the air-to-air modes. Scan edges are shown by radial lines from the ownship to the edges of the display. Cursor location is indicated by a vertical and horizontal line with the cursor location at the intersection. The cursor is used in GM and GMTI modes to select targets or the "quick step" feature may be used to cycle through detected targets by pressing the "Cycle Sensor Target" (keyboard "1")as in air-to-air modes. The azimuth scan is always centered about ownship heading. If a tracked target passes outside scan coverage, the radar reverts to the appropriate search mode.

The range scale works in the same way as air-to-air mode. Only radar detectable targets which are within scan coverage and detection range are displayed. Lines of constant range are shown (circles about ownship) at 25%, 50%, and 75% of the selected range scale.




**Radar Display Alphanumeric**

There are twelve windows which may display alphanumeric information. The windows themselves do not appear, they only indicate the location for the alphanumeric information. The window locations are shown in Figure 3.1-10. The content of each window is radar mode dependent and not all windows are used in every mode. The following table indicates the content of each window in each radar mode.

Window - Content

AA/RWS Mode

1 - Radar mode RWS
2 - n/a
3 - n/a
4 - n/a
5 - n/a

6 - Range scale in nm.
7 - Azimuth 1/2 scan(+/-) size in ten degree increments
8 - Upper altitude coverage at cursor range in Kft
9 - Lower altitude coverage at cursor range in Kft
10 - Target altitude (when selected) in Kft
11 - Number of elevation scan bars
12 - Target range (when selected) in nm

AA/SAM Mode

1 - Radar mode SAM
2 - Designated target aspect angle in ten degree units right or left of tail aspect
3 - Designated target heading in degrees from North
4 - Designated target speed in knots calibrated
5 - Designated target closing rate in knots calibrated, + opening and - closing
6 - Range scale in nm
7 - Azimuth 1/2 scan (+/-) size in ten degree increments
8 - Upper altitude coverage at designated target range in Kft
9 - Lower altitude coverage at designated target range in Kft
10 - Designated target altitude in Kft
11 - Number of elevation scan bars
12 - Range to designated target in nm

AA/STT Mode

1 - Radar mode - STT
2 - Target aspect angle in ten degree increments left or right of tail aspect
3 - Target heading in degrees from North
4 - Target speed in knots calibrated
5 - Target closing rate in knots calibrated, + opening and - closing
6 - Range scale in nm
7 - n/a
8 - n/a
9 - n/a
10 - Target altitude in Kft
11 - n/a
12 - Range to target in nm

AA/ACM Mode

1 - Radar mode - ACM
2 - Target aspect angle in ten degree increments left or right of tail aspect
3 - Target heading in degrees from North

4 - Target speed in knots calibrated
5 - Target closing rate in knots calibrated + opening and - closing
6 - Range scale in nm (only 5 or 10 available)
7 - n/a
8 - n/a
9 - n/a
10 - n/a
11 - n/a
12 - Range to target in nm

AA/TWS Mode

1 - Radar mode - TWS
2 - Designated target aspect angle in ten degrees increments left or right of tail aspect
3 - Designated target heading in degree from North
4 - Designated target speed in knots calibrated
5 - Designated target closing rate in knots calibrated + opening and - closing
6 - Range scale in nm
7 - Azimuth 1/2 scan (+/-) size in ten degree increments
8 - Upper altitude coverage at cursor range in Kft
9 - Lower altitude coverage at cursor range in Kft
10 - Designated target altitude in Kft
11 - Number of elevation scan bars
12 - Range to designated target in nm

AG/GM Mode

1 - Radar mode - GM
2 - n/a
3 - n/a
4 - n/a
5 - n/a
6 - Range scale in nm
7 - Azimuth 1/2 scan (+/-) size in ten degree increments
8 - n/a
9 - n/a
10 - n/a
11 - Number of elevation scan bars (always 1)
12 - n/a

AG/FTT Mode

1 - Radar mode - FTT

2 - n/a
3 - n/a
4 - n/a
5 - n/a
6 - Range scale in nm
7 - n/a
8 - n/a
9 - n/a
10 - n/a
11 - n/a
12 - Range to target in nm

AG/GMTI Mode
1 - Radar mode - GMTI
2 - n/a
3 - n/a
4 - n/a
5 - n/a
6 - Range scale in nm
7 - n/a
8 - n/a
9 - n/a
10 - n/a
11 - Number of elevation scan bars (always 1)
12 - n/a

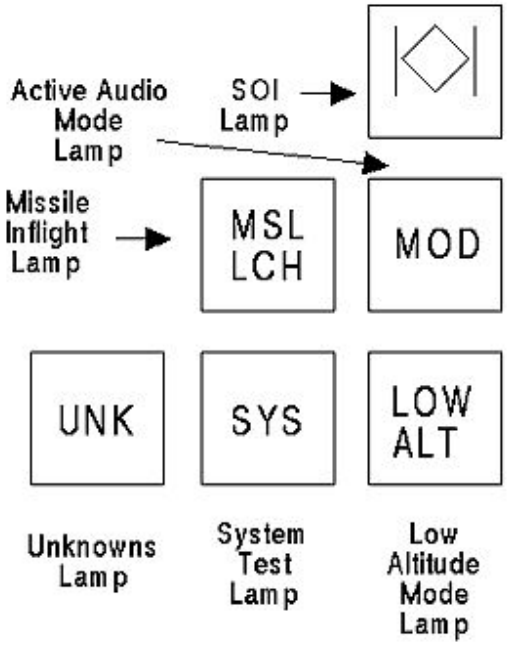
AG/GMTT Mode

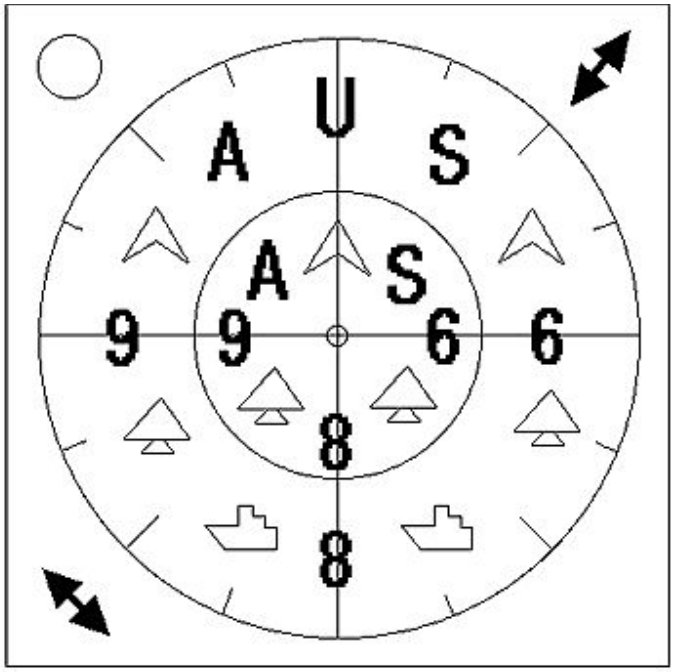
1 - Radar mode - GMTT
2 - n/a
3 - n/a
4 - n/a
5 - n/a
6 - Range scale in nm
7 - n/a
8 - n/a
9 - n/a
10 - n/a
11 - n/a
12 - Range to target in nm

## 3.2 THREAT WARNING INDICATOR

The F-16-C has an ALR-64 radar warning receiver which helps a pilot's situation awareness of other radiating systems within detection range. "Back to Baghdad" includes a Threat Warning Indicator (TWI) which encompasses most of the functions of the ALR-64 plus some features of new missile warning systems. The TWI includes a CRT like display plus six indicator lights. It is always operating. It may be selected as the sensor of interest by pressing "Cycle Sensor of Interest" (keyboard "8"). When it is selected as the sensor of interest, the pilot has additional functions at his disposal.

When any radiating source is within detection range of ownship, the TWI will become aware of its presence and display the appropriate symbol at the angular location of the source relative to ownship. Source symbols are shown in the outer ring unless they are closer than a critical range. This range is threat type dependent and indicates that the source is a potential current threat to the ownship. At this range the symbol moves to the inner ring on the display. Angular location of the symbol in quantized to one one of twelve locations in the outer ring and one of eight in the inner ring. Threat symbology is shown in Figure 3.2-1 and Figure 3.2-2.
If more than one threat is detected within the same display window, the highest priority one is displayed and a multiple threat is indicated by a line over the symbol. Threat priority is a function of ownship altitude and threat danger to ownship. For instance, threats in a firing mode are given a higher priority than the same threat in search mode. And potential shooters are give higher priority than early warning search sensors. Pilot control over low or high altitude priorities is available by the toggling the "shift/Cycle Sensor Mode" function (keyboard "Shift-2"). When low altitude priorities are selected, the LOW ALT indicator illuminates. The TWI includes a set of audio warnings. When a new source is first detected a series of four short beeps are heard. When a weapon sensor is detected in missile launch mode, a higher pitch continuing series of beeps are heard and the symbol for that source is enclosed in a circle. When a missile launch is detected, that sound becomes continuous and the MSL LCH lamp is illuminated.
The TWI may be selected as the Sensor Of Interest (SOI) by cycling the SOI function (keyboard "8"). The SOI indicator illuminates when the TWI is selected giving the pilot more control over the TWI. Upon entering this mode, the highest priority target will be indicated by a diamond around the symbol on the display. Cycling the "Cycle Sensor Mode" (keyboard "2") will select the active audio mode (MOD illuminates) which will allow the pilot to listen to the audio sound of the diamond target. In this mode the targets may be cycled by activating the "Cycle Sensor Target" function (keyboard "1") which will step through the targets in decreasing priority. The selected target is indicated by a diamond around it on the display. If multiple targets exist in any location on the display, they will also be cycled when their priority is reached.




| Threat Symbols | | | | Symbol Enhancements |
|---|---|---|---|---|
| U | Unknowns | A | AAA | Diamond Target |
| | Aircraft - Older<br>Aircraft - Search | 6 | SA-6 | |
| | | 8 | SA-8 | Msl Activity |
| | Aircraft - Newer<br>Aircraft - Strike | 9 | SA-9 | |
| S | EW/Search Radar | | | Multi Threats |
| | Shiborne Radar | | | |

## 3.3 TELEVISION SIGHT UNIT (TVSU)

The TVSU is a display capability programmable on either MFD which allows the pilot to `see` the image being generated by his guided air to ground weapons. Overlayed on the 3-D graphical image is weapon and target information to aid in the deployment of weapons. Each of the guided air to ground weapons; AGM-65, Maverick and GBU-10 Laser Guided Bomb, have a seeker unit with high powered optics from which a TV image is generated and displayed inside the cockpit. This image is available for both pre- and post-launch viewing, with the post-launch image taking priority over pre-launch images. The Field of View (FOV) is selectable as a normal (1.5 degrees) or wide (3.0 degrees) where greater area coverage or higher magnification is desired. In either pre- or post-launch mode, the image is slaved to the

seeker boresight. In pre-launch mode, seeker lock and weapon in range status is displayed, along with a target designator box (if a target is locked up) and a depiction of seeker look angle with respect to gimbal limits for the selected weapon.

To bring up and operate the TVSU, first and foremost, you must have either the AGM-65 or the GBU-10 onboard, so be mindful when selecting weapons for your mission. Once airborne, use the Cycle AG Weapon Up/Down control to select either weapon, then Cycle Right/Left MFD control to bring the TVSU image on the MFD of your choice (Note you have the option to use the View controls to fill the entire screen with the MFD display, too). Selected weapon and its onboard/inflight status is displayed in the lower left hand corner. FOV selection, toggled with the Cycle Az Scan Volume control, is displayed in the upper left hand corner.
In order to slew the view around, you must make the EO sensor the Sensor of Interest (SOI), using the Cycle Sensor of Interest control. Selection of the EO sensor as the SOI will be denoted by the illumination of the red light just below the corner of the display. Once selected, seeker boresight slewing can be effected by mouse or keyboard input (Cycle Az/El Scan Direction Up/Down). Note as you move the seeker boresight around, the little cross moves about the display. This provides a graphical representation of seeker look angle with respect to gimbal limits and when you bump it up against the edge, you are against the gimbal stop. The intersection of the vertical and horizontal reference lines is along the boresight of the seeker and using the left mouse button or the Designate Target key causes the seeker to lock on the point under the intersection. If a target is in the vicinity of that point, a Target Designator box will appear. In either case, the 'LOCK' text appears in the lower right hand corner of the display. When the EO seeker is locked, it tracks the locked point until one of two conditions arise, either the mouse button or Designate key is depressed again (it works like a toggle switch), or the geometry to the track point causes the EO seeker to exceed its gimbal limit. Watch your seeker angle cross and note the only way to keep the track point inside gimbal limits is to steer the aircraft towards it. If the seeker has locked on a target (denoted by the presence of the TD box), the 'IN RNG' indicator just above the 'LOCK' text will appear when the weapon is within deployment range. Death and destruction is only a pickle push away.
Once the weapon has been released on the unsuspecting millions of Saddam Hussain, the TVSU display de-clutters everything except the reference lines and indication of weapon type and inflight status. You will have the time of your life as you watch the seeker home in on the target below. After impact, the screen goes blank for a brief delay and the next EO weapon (if available) becomes the source of the display image.
There are some physical limits imposed on the employment of the TVSU, The maximum range for any track point is approximately 30 miles and attempts to lock on anything beyond that range will be futile. The boresight of the seeker must be pointed down at least 0.25 degrees from the horizon (no fair locking up other airborne aircraft!) before track point designation can occur. There are no minimum or maximum target size restrictions for designation.
As these weapons are intended to engage ground targets, the seekers are offset in the vertical plane to facilitate look down angles. This phenomenon is easily observed by flying straight and level, slewing the seeker up until the horizon is visible, and noting that the position of the seeker

angle cross is displaced above the horizontal reference line. The actual values for each weapon type are:
Weapon - Maximum Gimbal Angle - Elevation Offset
AGM-65 +/- 40 Degrees -17.0 Degrees
GBU-10 +/- 20 Degrees -15.0 Degrees
Bringing up the radar in air to ground mode, selecting the EO weapon, and then bringing up the TVSU will cause the EO seeker to attempt to lock up the radar designated target. If the target is within gimbal and range limits, the TVSU will come up in 'LOCK' mode with the target and TD box centered on the display. This is the only interaction between the radar and the TVSU, as they are independently controlled sensors. In the case that separate targets are being tracked by the radar and the TVSU and an EO weapon is released, the TVSU target takes precedence over the radar target.

## 3.4 JTIDS DISPLAY

"Back to Baghdad" has a stylized Joint Tactical Information Display System or JTIDS. This is a global PPI (Plan Position Indicator) display with the ownship at the center. It presents all aircraft locations and heading, identification (unknown, friendly, or hostile), and in ILS Mode, inner and outer marker locations, and way point or steering cue location. It appears on either Multi-Function Display (MFD) at the pilots command and is useful for getting the big picture and the location of other aircraft.
The JTIDS may be selected on the left MFD by pressing "Cycle Left MFD" (keyboard "5") repeatedly until it appears. Similarly, it may be selected on the right MFD by repeated pressing of "Cycle Right MFD" (keyboard "6"). As with all MFD selections, a display appearing on one MFD cannot be selected for the other MFD. The JTIDS incorporates selectable range scales of:
5 nm
10 nm
20 nm
40 nm
80 nm
These are measured from the ownship location at the center of the display. They are selected by pressing "Cycle JTIDS Range" (keyboard "o") to increase range scale or "Shift-Cycle JTIDS Range" (keyboard "Shift-o") to decrease range. Current range scale is displayed in the lower left hand corner of the display in nautical miles (NM) between up and down arrows. When the range scale is 80 nm the up arrow in not displayed and when the range scale is 5 nm the down arrow is not displayed. For all other range scales both are displayed indicating that the range scale may be increased or decreased.
The JTIDS Display is oriented with ownship heading up. When ownship is maneuvered left or right, the display will appear to rotate the opposite direction.
Aircraft are displayed at their bearing and range from ownship by one or three symbols:
Open square - unknown ID
Solid square - friendly
Solid star - hostile

Each symbol has a small line indicating that aircraft's heading to the nearest octant providing crude target aspect information. The aircraft information is assumed to come from sources other than ownship such as AWACS. Once an aircraft is identified as hostile or friendly by ownship, the ID will be retained on the JTIDS display throughout the remainder of the mission. Missions with a wingman will begin with the wingman ID as friendly. All other aircraft require the ownship to ID them during the mission.
When ILS mode is selected, the JTIDS display will show the location of the outer marker as a Hollow square with a hat on top, the inner marker as a hollow square with hat under it, and the landing location by an inverted T. These three symbols will line up in a line indicating the correct approach direction. The inverted T will also indicate the next way point in navigation mode.

## 3.5 IFF SYSTEM

The F-16C is equipped with an Identification Friend/Foe (IFF) system. Your aircraft is set to squawk the appropriate IFF signal at all times to reduce any possibility of fratricide against ownship. To interrogate an unknown entity, the entity must be detected by one or more of your avionics systems. The target of interest on the radar is the entity interrogated upon request by the pilot. The result of the interrogation is depicted on the information window on the upper right of the cockpit displays. A negative reply (meaning the entity is not squawking the proper frequency) is met with a No Reply signal as shown in figure 3.5-1. A proper, friendly response is shown in figure 3.5-2. A friendly response also invokes an audio cue.
Aircraft displayed on the JTIDS display have their ID information presented after the ownship has interrogated the specific aircraft. The ID is maintained for the balance of the mission. There is no display for depicting the ID of ground forces. They can be interrogated by declaring them the target of interest on the ground radar and issuing an IFF request. Their response is depicted in the information window and audibly just like airborne entities. But the pilot must develop methods for maintaining situation awareness of ground force ID.

## 3.6 ON-BOARD WARNING SYSTEM

The F-16C is equipped with an audio warning system known as Bitchin' Betty. The system provides verbal warning cues for low altitude, low speed, low fuel, an improper landing gear setting, and an upcoming waypoint.
Digital audio warning cues are provided for RWR signals including missile launch, IFF response, and a general warning beep if the player has done something inappropriate (i.e. bad inputs).

# 4.0 HEADS-UP DISPLAY

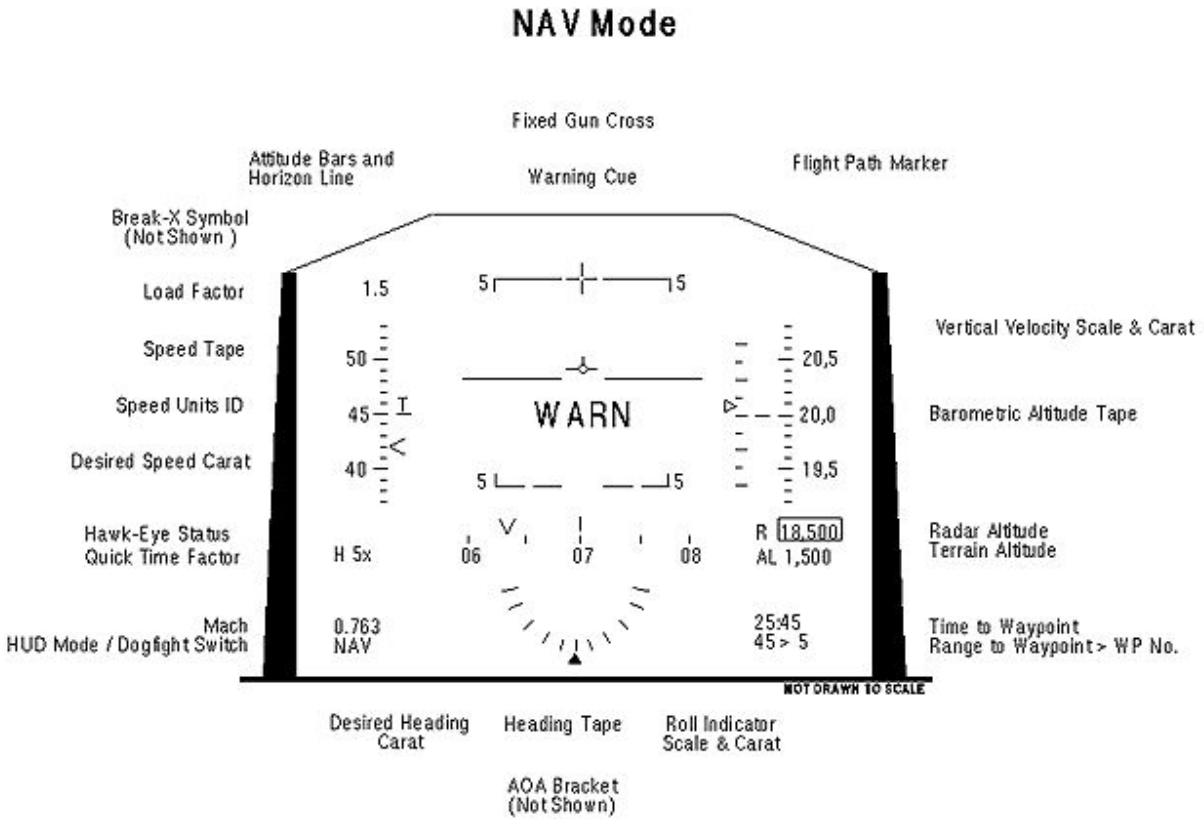
The Heads-Up Display (HUD) is the primary flight and engagement display. Its mode varies with many factors including weapon select, navigation options, and radar track status. Each of the modes are briefly described below along with a figure depicting and labeling all display windows within each HUD. Note that not all windows described for any given HUD mode are necessarily active at the same time. Further, many aspects of each HUD mode can be removed through the use of the de-clutter command on the keyboard. For each mode, there is an annotated figure. In general, the figures are self-explanatory. The descriptions below provide explanations where

appropriate for elements of the HUD displays. Where a display parameter is used on more than one HUD mode (such as the altitude tape), the explanation occurs only for the first HUD mode described and is not repeated for each HUD mode.

## 4.1 NAVIGATION MODE

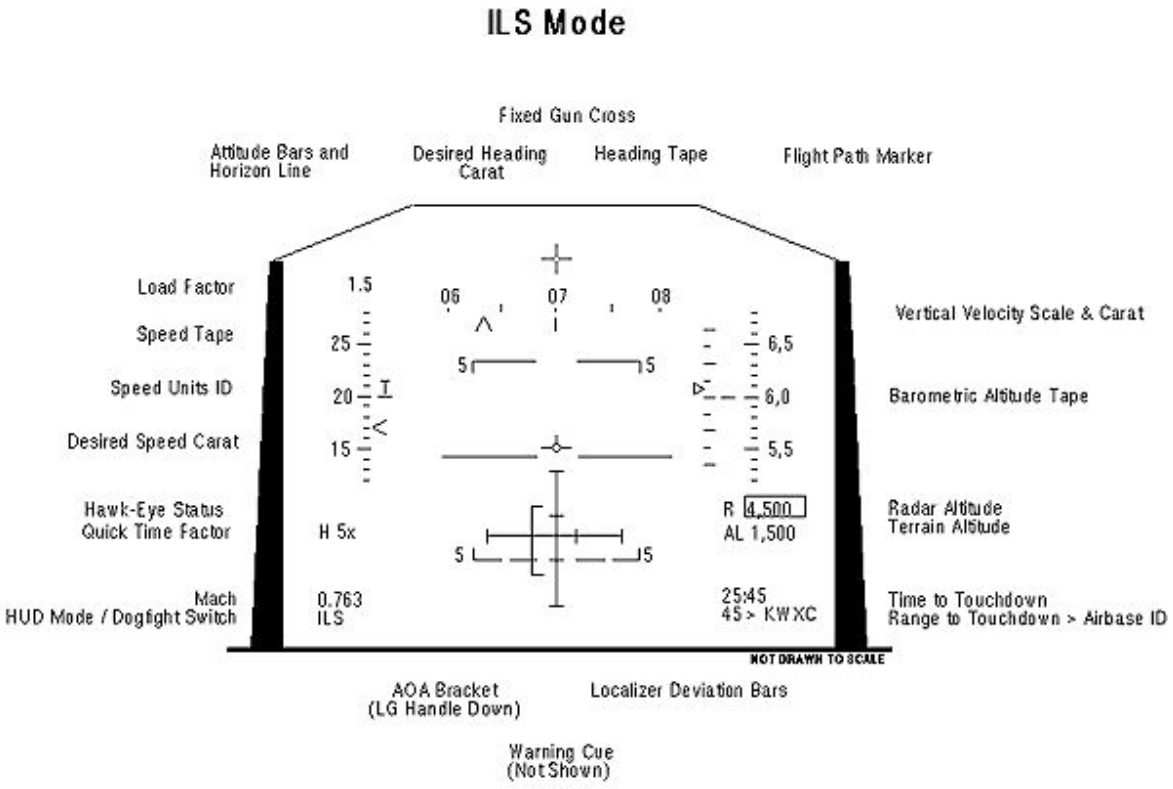
Figure 4.1 depicts the Navigation mode of the HUD. The Navigation Mode appears when the TACAN is on and no weapon is selected. Down the left side, airspeed is presented in knots in the form of a moving tape and a fixed caret. On the outer right side, altitude is presented in thousands of feet with a moving tape and a fixed caret. To the left of the altitude tape is the flight path marker tape. This is a fixed tape. moving caret indication of your elevation angle flight path relative to the next waypoint altitude.

Across the middle bottom of the display is a moving tape indicating heading in tens of degrees. A moving caret is displayed on top of the heading tape to indicate the next waypoint bearing. Centering the caret on the middle indicator of the tape puts you in a correct horizontal heading to reach the next waypoint. The caret is pegged to the right or left when the desired heading is beyond the range of displayed headings. On the very bottom of the display is a roll indicator showing the current roll angle of the aircraft relative to the horizon. Located vertically through the middle of the HUD is the pitch ladder. When you are flying straight and level, the longer, solid line of the pitch ladder will be aligned with the horizon in the distance. As you pull up, the pitch ladder will indicate your climb or dive angle via the solid (climbing) or dotted (diving) line that is presented in the middle of the HUD. The solid/dashed lines are in five degree increments.



## 4.2 ILS MODE

Figure 4.2 depicts the ILS mode of the HUD. ILS mode is presented when ILS is selected on the keyboard and an airbase has been selected. The heading tape and caret are relocated to the top of the display. Vertical and azimuth steering location deviation bars (with four notches in each) indicate where your current flight path is relative to the ideal glide slope. Aligning the two bars into a cross in the center of the HUD lines you up for a proper landing. There is also an Angle of Attack bracket displayed via which the proper aircraft angle of attack can be maintained.

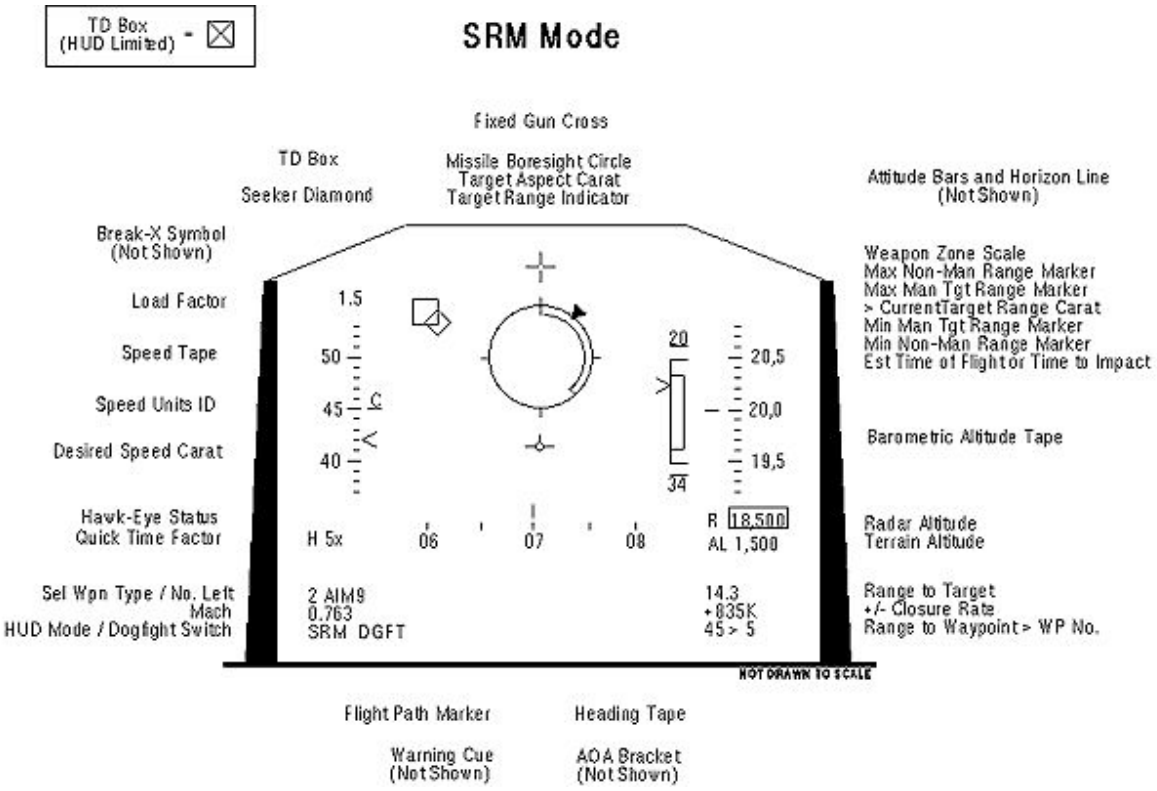



## 4.3 SHORT RANGE MISSILE MODE

Figure 4.3 depicts the SRM HUD mode. There are three new pieces of information displayed in SRM mode. To the left of the altitude tape, information describing the performance of the missile is presented. Maximum and minimum range of the missile are displayed as a boxed in area along a range bar. The range in miles represented by the range bar is indicated by the number at the top of the range bar. At the bottom of the range bar is the time of flight (prior to launch) or the time to impact (after launch) presented in seconds.

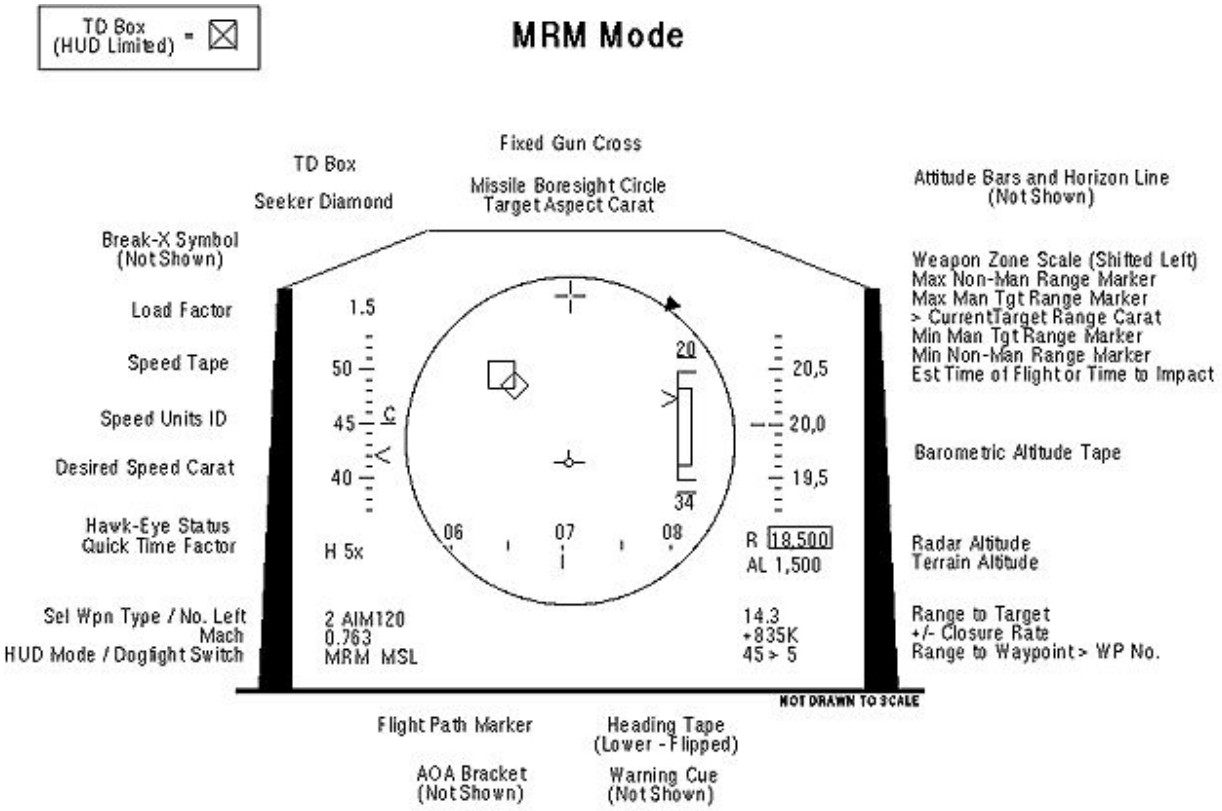
The box at the upper left of the figure is the TD Box. This box indicates the direction the target is currently located. Looking into the box will point you in the correct direction to the target. Putting the box in the middle of the HUD means you are pointing directly at the target. The diamond displayed near the TD Box indicates where the missile seeker is currently pointing. If the target

is being tracked, the diamond will be oriented near the TD box. When the tracked target is outside the field of view of the HUD, the TD box is pegged at the outside of the HUD in the correct direction towards the target.
In the center of the HUD is the missile boresight circle. If the target is located within this circle, the SRM should be capable of self tracking. If an audio tone is present, you have a valid shot. Inside the missile boresight circle is a target range indicator. When SRM is selected and the target is within two miles, the circle appears. The circle represents two miles in range. Thus, if the target is one mile away, target range indicator will start at the bottom of the circle; if the target is one-half mile away, the target range indicator will start at the three o'clock position. On the outside of the boresight circle, target aspect is indicated by the caret. Head-on aspect is indicated with the caret at the top of the circle, tail aspect presents the caret at the bottom of the circle.



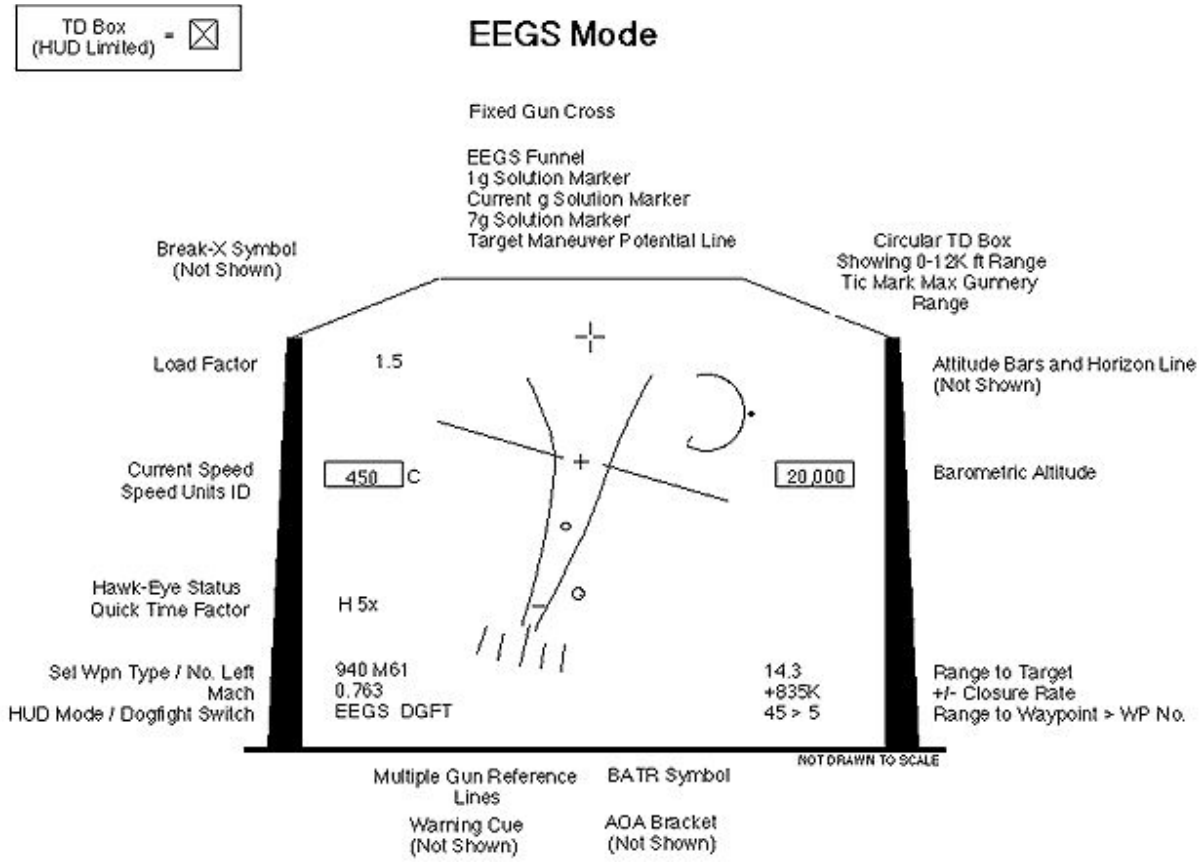

## 4.4 MRM MODE

Figure 4.4 depicts the HUD in MRM mode. The display is very similar to the SRM mode except there is no target range indicator and the boresight circle now presents allowable steering error for the aircraft.



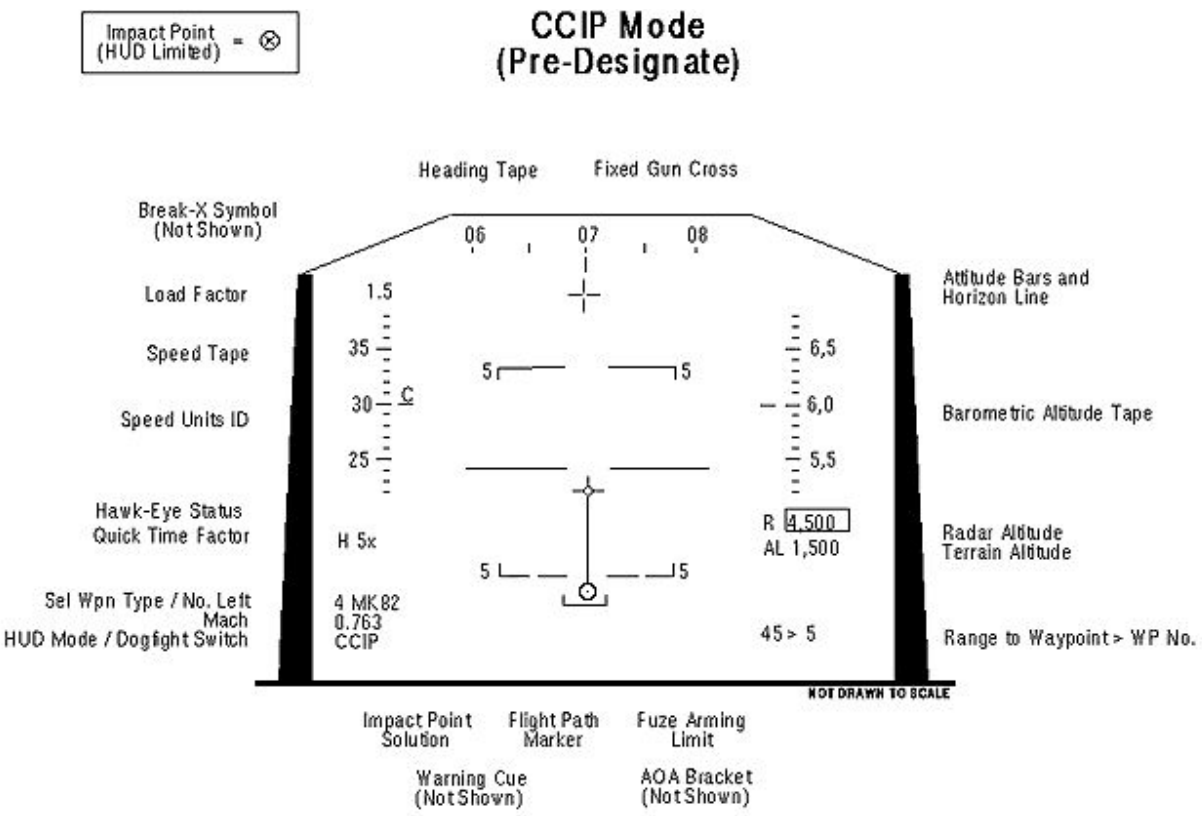

## 4.5 EEGS MODE

Figure 4.5 presents the EEGS mode of the HUD. The funnel represents the lethal pattern of the bullet flight path. When the displayed target fills the funnel, the bullets should impact the target. The horizontal bar across the funnel is the out-of-plane maneuver bar. This indicates the targets perpendicular maneuver plane and where the target could maneuver to during the bullet flight time. If the target is expected to change his maneuver direction, the worst case change in relative position is indicated by the ends of the bar. The pattern of lines across the bottom are reference lines to help the pilot align with the target/funnel shape.



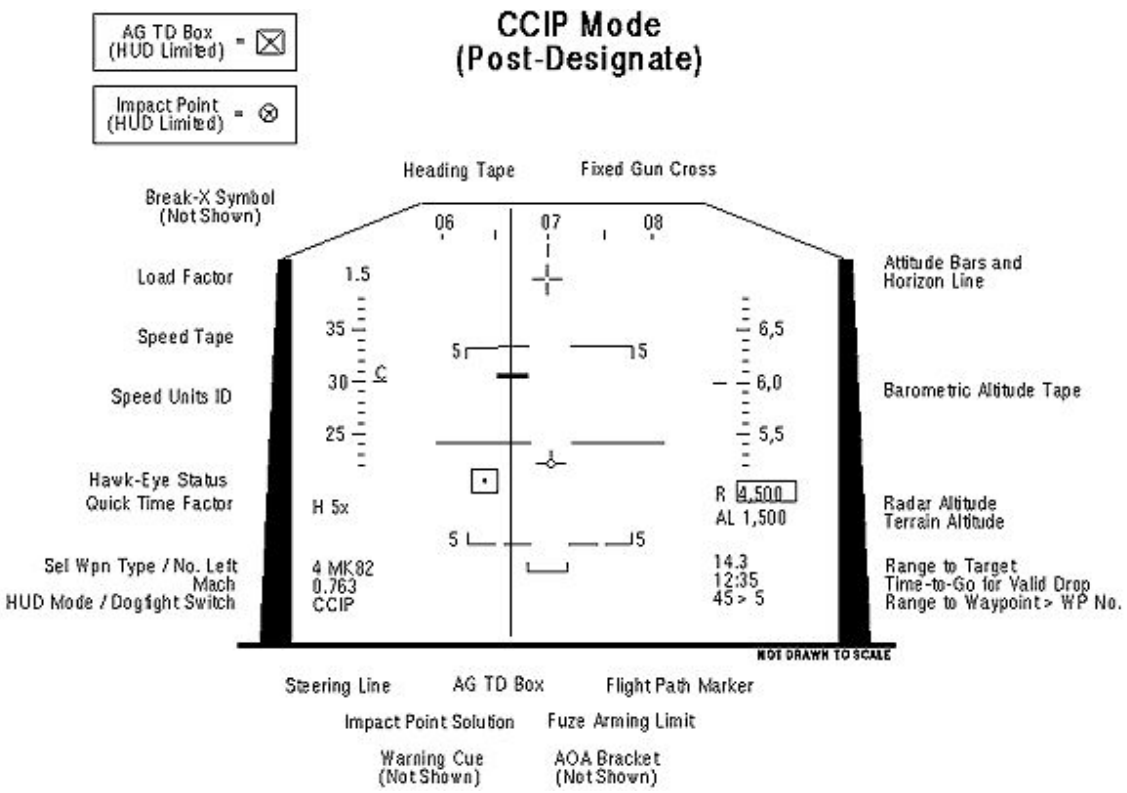

## 4.6 PRE-DESIGNATE CCIP MODE

Figure 4.6 depicts the CCIP mode of the HUD before a target is designated. The line from the aircraft reference point (the small circle with the appearance of wings) to the circle with a dot in it indicates the path along which bombs will fall if released now. The bottom of the circle indicates when the bombs should be dropped. Placing the circle on top of displayed targets should result in a bomb impact near the target.



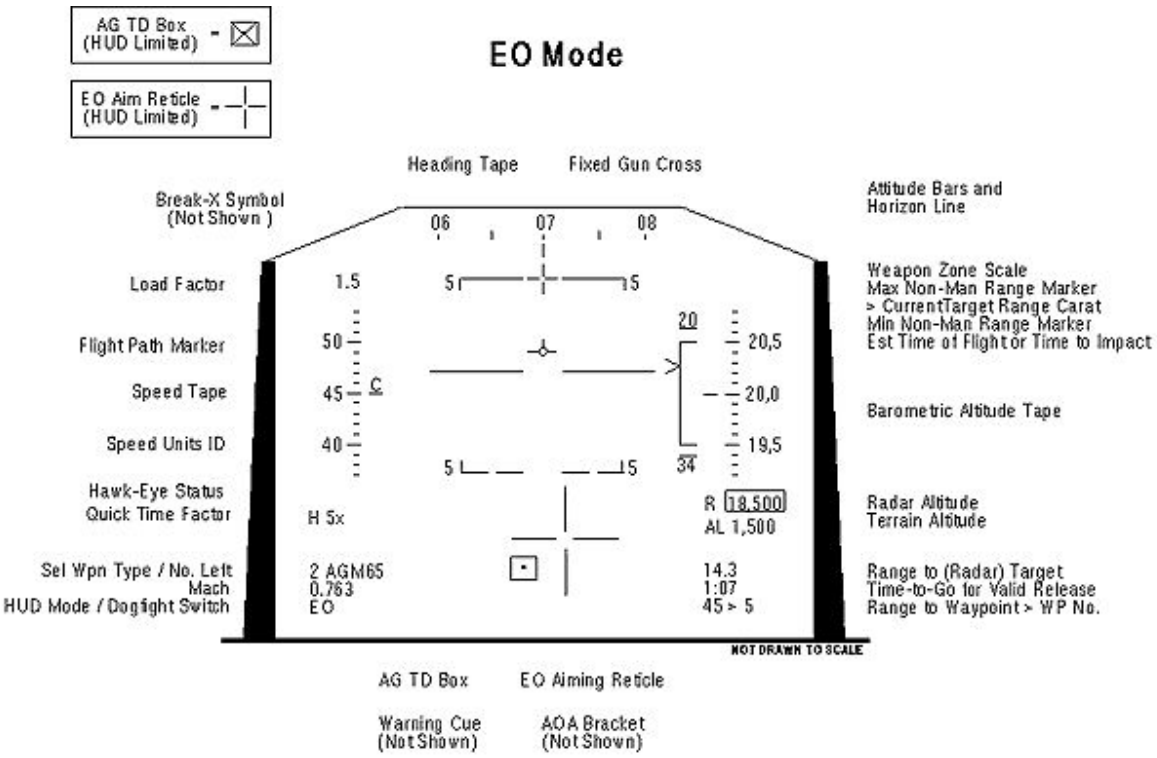

## 4.7 POST-DESIGNATE CCIP MODE

Figure 4.7 depicts the CCIP mode after a target has been designated on the radar. A vertical line now appears with a bar going through it. The bar will climb up the line as range to the target decreases. Aligning the vertical line with the target and dropping the bomb when the bar reaches the target will result in a bomb impact near the target.



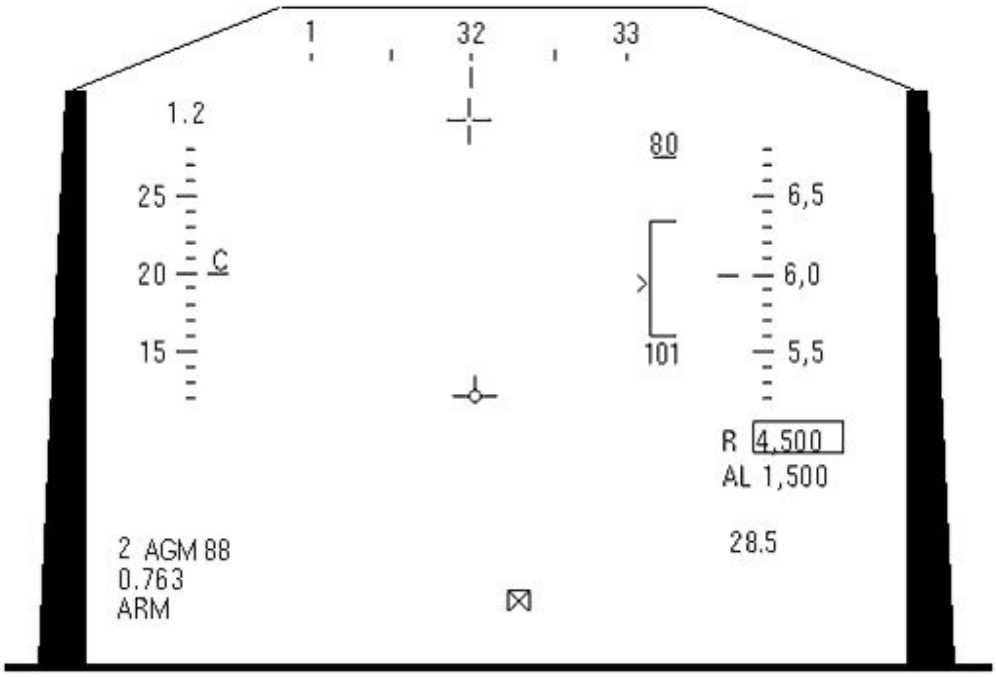

## 4.8 EO MODE

Figure 4.8 depicts the EO mode of the HUD. When an EO weapon is selected, the TD box indicates the direction of the target. The EO aiming reticle shows where the EO weapon is currently pointing. When the target has been locked on by the weapon, the reticle should be near the center of the TD box.




## 4.9 ARM MODE

Figure 4.9 depicts the HUD when an ARM missile is selected. A bar across the top of the TD Box is presented indicating the target is a radiating target.




Arm Mode

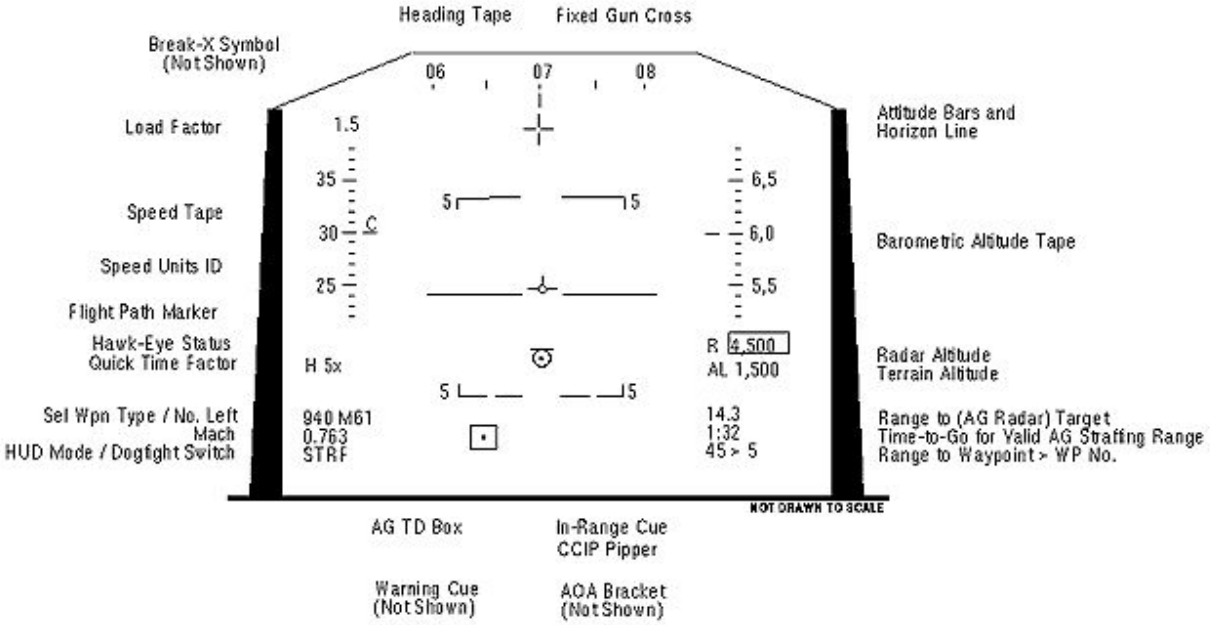
## 4.10 STRF MODE

Figure 4.10 depicts the HUD in gun strafing mode. The circle in the lower middle of the HUD is the gun pipper or aimpoint. The hat on top of the pipper indicates the gun is in range of the radar tracked target.

# STRF Mode

AG TD Box (HUD Limited) = ⊠

Impact Point (HUD Limited) = ⊗



## 5.0 NAVIGATION SYSTEM AND MFD

The F-16 is equipped with a complete navigation system including a Tactical Air Navigation (TACAN) system, an Instrument Landing System (ILS), ability to display a series of preplanned waypoints, and an autopilot. Navigation information can be displayed on either of the MFDs when the MFD has properly selected the navigation display option (by cycling the MFD selection). Figure 5.0.1 depicts the Navigation Display when properly selected.

The four windows near the top of the display depict (clockwise from the upper left) estimated range given the remaining fuel, mission time, elapsed time since the beginning of the mission and estimated time to use the remaining fuel.

The lower eight windows provide information regarding either waypoints or your home base. When the TACAN is on, the information relates to a waypoint. When the ILS is on, this information is overridden with information regarding your home base. In clockwise order from the upper left of the eight windows, depicted is waypoint or airbase number, range to the location, bearing to the location, speed required to reach the location, estimated mission time of arrival at location, desired altitude at location, longitude of location, and latitude of location.

In addition to the information provided on the Navigation Display, waypoint information is also displayed on the radar, JTIDS, HUD in NAV mode. ILS information is displayed on the HUD in ILS mode. Descriptions of the displays are available in the appropriate sections of this manual.

The F-16 has an autopilot to relieve the load of flying the aircraft during quiet periods. There are two different traits to the autopilot depending on TACAN status. When the TACAN is OFF, turning the autopilot ON will quickly put the aircraft into a stable Altitude Hold/Bearing Hold profile - the pilot still controls the speed via throttle setting. When the TACAN is ON, turning the autopilot ON will cause the aircraft to change heading to point to the next waypoint. In this mode, the autopilot still holds altitude and the pilot controls speed. Thus, while selecting autopilot will get you to the waypoint X,Y location, you may arrive at a different altitude than recommended and at a different time than desired. Note that when the autopilot in ON, the pilot has no control over altitude.

## 6.0 AIRCRAFT STORES DISPLAY

Aircraft stores information can be displayed on either of the MFDs when the MFD is properly selected to the stores display option (by cycling the MFD selection). Figure 6.0.1 depicts the Aircraft Stores Display when properly selected.

The display shows the 9 stations from which payloads can be hung. At each station is displayed the payload type and the number of them remaining. Items highlighted at a particular station indicate that particular station is ready for action. Nominally, that action is either next weapon release or jettison. The nine stations, eight on the wings and a belly station, are presented in their relative location on the aircraft.

At the bottom of the display are four status windows. Clockwise from the upper left, they represent number of gun rounds remaining, the next station from which to jettison payloads (including all), the number of MJU-8 flares remaining, and the number of RR-170A chaff bundles remaining.

## 7.0 DAMAGE AND MALFUNCTION DISPLAY

Damage and malfunction information can be displayed on either of the MFDs when the MFD is properly selected to the damage/malfunction display option (by cycling the MFD selection). Figure 7.0.1 depicts the Damage and Malfunction Display when properly selected.
Status of 15 aircraft systems is provided. When a system is down or damaged, due to either battle damage or an inflight malfunction, the particular system icon is highlighted. The impact of the inoperable system obviously varies as a function of the system - some are quite mission critical while other inoperable systems may allow you to continue the mission.
ENG- Engine
RDR - Radar
AP - Autopilot
FUL - Fuel
WPN - Weapon launch system
ECM - Jammer
HYD - Hydraulics
GUN - M61A1 gun
IFF - IFF
OXG - Oxygen
EXP - Countermeasure dispenser
ILS - ILS
LGR - Landing Gear
RWR - Radar warning receiver
SPB - Speed Brake

## 8.0 COUNTERMEASURES

"Back to Baghdad" includes three types of countermeasures representative of the real world; Chaff, Flares, and Jamming.

## 8.1 CHAFF

Chaff is the name given to finely cut strips of plastic coated with a radar reflecting material. It is usually packaged into tightly packed bundles of either multiple or single length strips. Each strip acts as a reflective dipole to radar energy with a wave length near the length. Individual bundles contain a large number of strips and are broken open when ejected by an aircraft. The bundle material is disbursed by the air flow into what is called a chaff cloud. It takes time, called "bloom time", for a bundle to form a cloud. As the cloud forms, its radar cross section grows to several hundred square meters which is larger than most airborne targets. When ejected, the chaff bundle is traveling at the same velocity as the aircraft which discharged it. But, due to the very very small weight of each reflecting strip, it decelerates very rapidly (around 100 gs). For all practical purposes it stops nearly instantly.
Because chaff forward motion stops so fast and the gravity effect is small due to small weight and large surface area, the cloud tends to hang in the air for several minutes. Its large radar signature shows up primarily on pulse radar with each cloud appearing as a large target. But its lack of motion makes it distinguishable from aircraft over time. The lack of chaff motion makes it ineffective against doppler radar and doppler seekers. Its primary effect on pulse radar is to present many targets to the operator causing confusion and delays in finding the real aircraft

target. For fire control radars that are affected, it can delay launching of missiles or cause track breaks for radar directed AAA guns.
Chaff effects are included in "Back to Baghdad" as delays in track acquisition and weapon firing for pulse radar. The severity of the effect varies with the threat difficulty setting you have selected. The delays will help improve your chances of avoiding being hit by ground defenses. However, aircraft are only able to carry a limited number of chaff bundles. In game modes where these limits are imposed, chaff use should be reserved for situations where it has the most payoff.

## 8.2 FLARES

Flares are small pyrotechnic devices that are ejected from aircraft to decoy and/or confuse IR guided weapons. They are ignited on ejection and require a few tenths of seconds to reach full intensity. They are designed to burn very brightly for about four seconds with their spectral energy concentrated in the bands used by IR missile seekers. When properly employed, they can be effective at decoying IR missiles. When a flare is ejected, it starts at the same velocity as the aircraft and then decelerates slowly due to aerodynamic drag. If the flare is still in the missile seeker beam when its brightness exceeds that of the aircraft, it may "capture" the missile seeker. When captured, the missile will guide on the flare as long as it is brighter than the target signature. But, since the flare only burns for a few seconds, the missile seeker will re-acquire the aircraft if it is still in the seeker beam when the flare dies out.
Thus, flares can be effective against IR missiles if employed during the last four seconds of missile flight. This may be difficult to accomplish since the pilot may not know when this occurs. Because of this, often flares will be ejected one after the other when the pilot thinks he is under attack. It does not help to eject flares too close together, one every three or four seconds will do. As with chaff, aircraft are only able to load a limited number of flares. In fact, most dispenser systems carry flares and chaff bundles interchangeably and the usual arrangement is a mixture. Thus wise use is important when in the more difficult game mode where the supply is limited. Flare effects on IR missiles is included in the game with their effectiveness higher for the more difficult modes. Both ownship and threat aircraft can employ flares and chaff.

## 8.3 JAMMING

Jamming is a generic name give to a class of countermeasures which emits RF energy in a attempt to disrupt radar performance. While there are many types of "jamming", one of the most common and widely applicable is "noise jamming". RF energy is transmitted on one or more frequencies with random noise modulation at high power levels. If the power density at a radar frequency is high enough, target returns are swamped (masked) thus denying tracking. Without a radar track, range, speed, and heading of a target are not known.
However, due to the high energy level required to be effective, a radiating jammer can be detected at very long ranges. Thus, employing a jammer reveals the jammers presence and direction to all opposing forces. This is a distinct disadvantage because it allows opposing forces to start reacting, including launching defending aircraft and alerting SAMs and AAAs. It also announces your presence to opposing aircraft allowing them to steer toward the jammer. Most aircraft and ground threat tracking radar can be jammed. If they have a target track when jamming begins, that track will usually be extrapolated for some amount of time. After that time,

tracking is not possible until the distance to the jammer is decreased to "burn through" range. At the burn through range, target reflected energy becomes larger than the jammer energy and tracking again becomes possible. But burn through ranges are very small for self protection jammers compared to non-jammed tracking ranges.
These effects are all modeled in Back to Baghdad. Both threat aircraft and the ownship may employ jamming. Its effectiveness varies with level of difficulty. Threat aircraft jamming is more effective within sixty degrees of their nose than in their rear due to jammer antenna patterns effects included. Length of threat jamming varies with difficulty level, longer for the higher difficulty. Ownship jamming can be effective against ground radar which are used by SAMs and AAAs. In general, weapons cannot be effectively fired without a target track. That is, without a target track, weapons will be unguided if fired. This is true for both ownship and threats.
If jamming is employed by any aircraft with a radar guided missile in flight against it, kill probability (Pk)will be reduced but not to zero. This is due to the ability of modern radar guided missile to home on jamming (HOJ). But being reduced to angle track only, the guidance and fusing will not be optimum, leading to reduced Pk. This effect is included in the game.
Use of the ownship jammer can have a useful effect and improve survivability when used properly. But it can have undesirable side effects such as increased early warning. Therefore, it should be employed where and when the advantages outweigh the disadvantages.

# 9.0 THREATS
# 9.1 AIR WEAPONS

***AA-8 APHID***

Length: 6 ft 10 in
Guidance: All aspect infrared seeker
Diameter: 5.125 in
Propulsion: Single stage solid propellant
Launch weight: 143 lbs
Warhead: 13.2 lb Blast fragmentation
Max speed: Mach 2.5
Nominal range: 1.85 nm
The Aphid is a short range soviet developed air-to-air missile with a Soviet designation of "R60". It is the successor to the AA-2 Atoll and is carried by most Russian fighter and attack aircraft. Intended for both interception and self defense, it is a highly maneuverable Infrared guided tactical missile. Large numbers have been built and exported. The Aphid will be launched by the threat aircraft when appropriate and within range for both the seeker and kinematic boundaries.
***AA-10 ALAMO***

Length: 13 ft 1 in
Guidance: Midcourse Command / Inertial
Diameter: 9 in Terminal semi-active radar

Launch weight: 558 lbs
Propulsion: Dual thrust solid propellant
Maximum speed: Mach 3.0
Nominal range: 25 nm

The Soviet developed Alamo Medium Range (MRM) air-to-air missile is replacing the AA-7. It is somewhat comparable to the US AIM-7F Advanced Sparrow. As standard MRM armament for the MiG-29 and Su-27, it's intended for both offensive and defensive rolls. There are six variants including both semi-active radar and infrared seekers and two different size rocket motors. The Soviet designation is R-27 with a letter indicating the variant. The R-27R variant, NATO designation AA-10A, is included in this game.
This missile will be launched by threats so equipped when tactically appropriate and within kinematic range. It must be supported by the launch aircraft radar to provide illumination for the semi-active seeker until intercept.

## 9.2 LAND BASED THREATS

***SA-6 Gainful***
Length: 19 ft
Guidance: Semi-active radar
Diameter: 13.2 in
Propulsion: Integral solid booster
Launch weight: 1.320 lbs Ramjet sustainer
Max speed: Mach 2.8
Warhead: 130 lbs HE fragmentation
Max altitude: 40,000 ft
Max range: 79,000 ft (13 nm)
The SA-6 is a Soviet developed low to medium altitude Surface to Air Missile (SAM). It has been widely exported and saw much use by Iraq in Desert Storm. It is known for its high average speed resulting from an integral solid state booster plus ramjet sustainer. Guidance is semi-active radar using illumination from the Straight Flush radar carried by its launch vehicle. While the mobile launcher carries three missiles, only one target may be attacked at a time. Usually employed in multiple launchers along with a battery command center and several search and acquisition radar. A naval version was evolved from the SA-6 which is designated SA-N-3 Goblet and is found on destroyer size ships.

***SA-8 Gecko***
Length: 10 ft 4in
Guidance: Command guided from launcher
Diameter: 8.26 in
Propulsion: Single stage solid propellant
Launch weight: 287 lbs
Warhead: 42 lb HE fragmentation
Max speed: Mach 2.4

Max range: 39,520 ft (6.5 nm)
Max altitude: 33,000 ft
The SA-8 Gecko is a soviet developed mobile command guided SAM. A single unit consists of a six wheel all terrain vehicle, a Land Roll radar, and missiles. Primarily intended for low altitude aircraft, including helicopters, it can attack only one target at a time but two missiles may be guided at once. Shipboard variants are designated as SA-N-4 but the missile is nearly identical. This variant is found on patrol type boats. Many units have been produced and widely exported including Iraq.

***SA-9 Gaskin***

Length: 5 ft 11 in
Guidance: Electro-optical seeker
Diameter: 4.72 in
Propulsion: Single stage solid propellant
Launch weight: 70 lbs
Warhead: 5.7 lb HE fragmentation
Max speed: Mach 1.8
Max range: 13,780 ft (2.27 nm)
Max altitude: 11,500 ft

The SA-9 Gaskin is a Soviet developed Electro-optical mobile SAM. Intended for low altitude aircraft, such as helicopters, it is a daylight anti-aircraft system usual employed at the divisional level. Large numbers were built and exported to countries, including Iraq. Since the missile is optically guided and launched, there is no radar and thus no warning of launch other than visual sighting.

***ZSU-23-4 Shilka***

Max range: 8,200 ft
Max altitude: 4,000 ft
Muzzle velocity: 3,200 ft/sec.
Max fire rate: 3200 rounds per minute
Max rounds per burst: 120
Time from target designation to first firing: 30 sec
The ZSU-24-4 is a Soviet developed mobile radar guided anti-aircraft gun. Four water cooled 23mm APZ-23M cannons each capable of firing at a rate of 800 bullets per minute are directed by the launch vehicle mounted Gun Dish radar. A total of 2000 rounds are carried in the launch vehicle. Gun barrel heating limits bursts to 30 rounds per gun. The guns are stabilized and may be fired when on the move. Optical sighting by the operators is used if the radar is jammed. Large numbers were produced and many exported including several hundred to Iraq.

## 10.0 FRIENDLY FORCES

This section presents other friendly aircraft which may appear in various missions.

***F-16 Falcon***

Max take-off weight: 27,000 lbs a-to-a;42,000 lbs a-to-g
Max speed: Mach 2.0+

Length: 49 ft 4 in
Wingspan: 31 ft
Height: 16 ft 8 in
Ceiling: 50,000+ ft
Combat Radius: 340 nm internal fuel 740 nm drop tanks

Single seat high performance multi-purpose fighter developed for the US Airforce and European Consortium by General Dynamics (now Lockheed Martin). Its primary role is attack missions but it has significant air-to-air capability. It is highly maneuverable employing fly-by-wire technology. Avionics include the APG-68(V) multi-mode Pulse Doppler radar with both air-to-air and air-to-ground modes. An internally mounted M61A1 20mm gatling gun with 510 rounds is included in all modes. Fighter role armament can include two AIM-9s on wing tip stations plus four AIM-120s on under wing stations. Ground attack missions can carry a large load of air-to-ground ordnance including bombs, AGM-65 Maverick, AGM-88 HARM, and AGM-84 Harpoon.

***F-5 Tiger***
Max take-off weight: 24,700 lbs
Max speed: Mach 1.64
Length: 47 ft 5 in
Wingspan: 26 ft 8 in
Height: 13 ft 4 in
Ceiling: 51,800 ft
Combat Radius: 120 nm (5,200 lbs ordnance)

Highly maneuverable single seat fighter primarily developed for export by Northrop for the US Air Force. Exported to over 20 countries and used by the USAF, this version (F-5E) has the pulsed APQ-159 radar with air search and track capability. Armament includes two M39 20mm cannons with 280 rounds each, two AIM-9s on wing tip launchers, and up to 7,000 lbs of air-to-ground ordnance including most bombs.
***F-15 Eagle***
Max take-off weight: 62,700 lbs
Max speed: Mach 2.5
Length: 63 ft 9 in
Wingspan: 42 ft 9 in
Height: 18 ft 5 in
Ceiling: Over 50,000 ft
Combat Radius: 685 nm
Single seat land based fighter and strike aircraft developed by McDonnell Douglas for the US Air Force. Avionics enclosed the APG-70 Pulse doppler radar with both air-to-air and air-to-ground modes. As the USAF's most capable fighter, its primary role is air superiority. It can climb vertically without losing speed. In the fighter role, it carries four AIM-9s and four AIM-120s plus an internally mounted M61A1 Gun with 960 rounds. In attack roles it carries a

wide variety of bombs and air-to-ground weapons including GBU-10, GBU-15, AGM-130, and AGM-88. With over 1000 produced, they have been exported to Israel, Japan, and Saudia Arabia.

***F/A-18 Hornet***
Max take-off weight: 36,710 lbs fighter mission;51,900 lbs strike mission
Max speed: Mach 1.8+
Length: 56 ft
Wingspan: 37 ft 6 in
Height: 15 ft 3 in
Ceiling: 50,000 ft
Combat Radius: 290 nm hi-lo-lo-hi

Single seat land and carrier based strike/fighter developed for the US Navy by McDonnell Douglas. Avionics include the APG-73 multi-mode radar with both air-to-air and air-to-ground modes. An M61A1 20mm gatling gun is mounted internally with 570 rounds and fires through the nose. In the fighter role armament includes two AIM-9 on wing tip stations and up to six AIM-120 AAMRAM missiles. In the air-to-ground role armament can include laser spot tracker, GBU-10, Mk 82 and Mk84 bombs, AGM-84 Harpoon, and AGM-65 Maverick. A large number have been built and many exported.

***F-111 Fighter***
Max take-off weight: 100,000 ft
Max speed: Mach 2.5 clean at altitude
Mach 1.2 at sea level
Length: 73 ft 6 in
Wingspan: 63 ft fully spread; 32 ft fully swept
Height: 17 ft 1 in
Ceiling: 59,000 ft
Combat Radius: 440 nm

A two seat (side by side) tactical swing wing fighter developed by General Dynamics for the US Air Force. Originally intended to serve US Navy needs, it's role was changed. A medium bomber version was also developed (FB-111) as well as an ECM version (EF-111). Armament includes one M61 20mm internal gun and a large assortment of air-to-ground ordnance.

***F-117 Nighthawk***
Max take-off weight: 52,500 lbs
Max speed: Mach 0.85
Length: 65 ft 11 in
Wingspan: 43 ft 4 in
Height: 12 ft 5 in
Ceiling: Unknown

Combat Radius: 570 nm
Single seat precision attack stealth aircraft developed by Lockheed for US Air Force. Primarily designed for precision attacks of high value, well defended targets, all ordinance is carried internally. No air-to-air capability. Very low radar cross section allows penetration into high threat areas.

***Tornado***

Max take-off weight: 61,700 lbs
Max speed: Mach 2.2 clean; Mach 0.92 external stores
Length: 54 ft 10 in
Wingspan: 45 ft 7 in fully spread; 28 ft 2 in fully swept
Height: 19 ft 6 in
Ceiling: unknown
Combat Radius: 750 nm
Single seat swing wing multi-mission fighter/attack aircraft developed by Panavia for the British, German, and Italian governments as a joint venture. Avionics are extensive including a Texas Instruments designed European built multi-mode forward looking terrain following ground mapping radar. Armament includes two 27mm cannon with 180 rounds each. For air-to-air missions it can carry four AIM-9s plus other stores. For interdiction missions it carries the full assortment of guided air- to-ground weapons plus bombs.

***A-4 Skyhawk***

Max take-off weight: 24,500 lbs
Max speed: Mach 0.85
Length: 40 ft 4 in
Wingspan: 27 ft 6 in
Height: 15 ft
Ceiling: 45,000 ft
Combat Radius: 400 nm

Single seat light attack and close support aircraft developed by McDonnell Douglas for the US Navy and Marines. Carries two 20mm Mk12 cannons with 200 rounds each plus 10,000 lbs of air-to-ground ordnance. No radar and no air-to-air capability except for visual use of guns.

***A-10 Warthog***

Max take-off weight: 47,500 lbs
Max speed: Mach 0.6
Length: 53 ft 4 in
Wingspan: 57 ft 6 in
Height: 14 ft 8 in
Ceiling: 25,000 ft
Combat Radius: 540 nm
Single seat close air support aircraft developed by Fairchild Republic for the US Air Force. Intended for use as a tank killer, it carries a 30mm GAU-8 multiple barrel high velocity gun using

depleted uranium ammunition which is capable of penetrating tank armor. It also carries four AGM-65 Mavericks. It has no radar and no air-to-air capability.

***B-1 Lancer***
Max take-off weight: 389,800 lbs
Max speed: Mach 2.0 at at 50,000 ft;Mach 0.98 at 500 ft
Length: 143 ft 3 in
Wingspan: 136 ft 8 in fully spread;78 ft 2 in fully swept
Height: 33 ft 7 in
Ceiling: 50,000+
Max Range: 5,300 nm

Swing wing Low altitude penetration bomber developed by Rockwell for the US Air Force. Intended to replace the B-52, the Lancer carries nearly twice the payload at near sonic speed at tree top level. Avionics include sophisticated ECM and four radar; APQ-140, APQ-144, APQ-146, and APN-145. Weapons are carried internally in three weapon bays. With a total weapon load of 115,000 lbs, this is a formable weapon system.

***B-52 Stratofortress***
Max take-off weight: 488,000 lbs
Max speed: Mach 0.8
Length: 157 ft 2 in
Wingspan: 185 ft
Height: 44 ft
Ceiling: 55,000 ft
Combat Radius: 3,000 nm

Long range heavy bomber developed by Boeing for the US Air Force. Originally developed as a strategic nuclear bomber (part of the "triad"), it has more recently served as a conventional bomber in Southeast Asia and Desert Storm. Avionics include extensive ECM and bomb/navigation radar operated by a crew of 6. As a very long range bomber with large payloads of nuclear weapons and standoff missiles, it complicates enemy defenses.

***E-2C Hawkeye***
Max take-off weight: 54,400 lbs
Max speed: Mach 0,52
Length: 57 ft 9 in
Wingspan: 80 ft 7 in
Height: 18 ft 3 in
Ceiling: 37,000 ft
Combat Radius: 175 nm with 4 hrs 24 min on station

Carrier and land based early warning and control aircraft developed by Grumman (now Northrop Grumman) for the US Navy. The 24 ft diameter rotodome houses the antenna for its APS-145

air and surface search radar. It is capable of detecting and tracking large numbers of targets at long range. With a crew of five,, it can provide overall battle management. The US Navy operates over one hundred and they have been exported to Egypt, France, Israel, Japan, Singapore, and Taiwan.

***E-3 Sentry***

Max take-off weight: 325,000 lbs
Max speed: Mach 0.7
Length: 152 ft 11 in
Wingspan: 145 ft 9 in
Height: 48 ft
Ceiling: 30,000 ft
Combat Radius: 1,000 nm

Known as "AWACS" (Airborne Warning and Control System), this aircraft was evolved from the Boeing 707-320 by Boeing for the US Air Force. It employs a 30 ft diameter rotodome on top of the fuselage to house the antenna for the APY-1 long range track while scan radar. Extensive communications and computer systems support the command and control missions along with a crew of 17 (4 flight crew plus 13 AWACS). The E-3 has seen use in nearly all armed conflicts over the last 15 years.

***KC-10 Extender***

Max take-off weight: 348,973 lbs
Max speed: Mach 0.88
Length: 181 ft 7 in
Wingspan: 165 ft 4 in
Height: 58 ft 1 in
Ceiling: 33,400 ft
Range: 3,797 nm

Air refueling equipped tanker developed from the DC-10 by McDonnell Douglas for the US Air Force. Capable of carrying 18,125 gallons of aviation fuel (jet or high octane or both) it is used to refuel other aircraft while airborne.

***C-130 Hercules***

Max take-off weight: 155,000 lbs
Max speed: Mach 0.48
Length: 97 ft 9 in
Wingspan: 132 ft 7 in
Height: 38 ft 3 in
Ceiling: 26,500 ft
Range: 1945 nm

Tactical transport and multi-mission aircraft developed by Lockheed for the US Air Force. More than a dozen models have adapted this aircraft to many missions for multiple US services. The USAF has purchased over 1100 and they have been exported to over fifty countries.